FBAE

# FOUNDATION FOR BIOTECHNOLOGY AWARENESS AND EDUCATION

No 1, Gupta's Layout, Southend Road, Bangalore 560 004, India
Ph.: 080-6549470; E-m.: krao@vsnl.com

## ANNUAL DAY
## WORKSHOP ON

# BIOTECHNOLOGY AWARENESS

## FOCUSSING
# BIOTERRORISM

## PARTICIPANTS' READING MATERIAL

**COMPILED BY THE FBAE IN PUBLIC INTEREST**

**JANUARY 28, 2002**

**IN THE AUDITORIUM**
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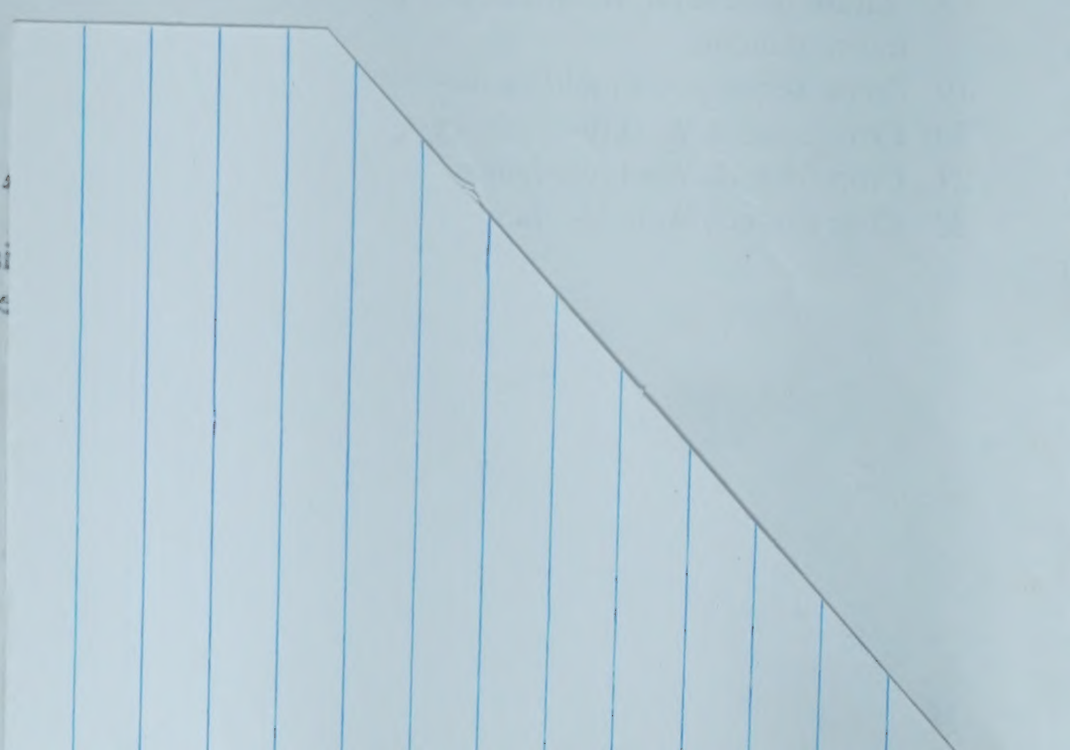

# FOUNDATION FOR BIOTECHNOLOGY AWARENESS AND EDUCATION

Registered Office:
No 1, Gupta's Layout, Southend Road, Bangalore 560 004, India
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## 1. THE FOUNDATION

The **Foundation for Biotechnology Awareness and Education** (FBAE) is a Registered, non-profit, grass-root, Society formed to support sustainable development through biotechnology, by promoting biotechnology awareness and education. The FBAE was inaugurated on January 18, 2001.

## 2. AIMS AND OBJECTIVES

### a) Aims

1. To create public awareness about the potential benefits and perceived risks of biotechnology intervention in i) sustainable development and utilisation of natural resources, ii) human, animal, and plant health, and iii) environmental protection;

2. To influence policies through partnering with academicians and educational institutions anywhere in the world to promote quality in biotechnology education and training; and

3. To influence public policy making to ensure safety and wider utilisation of biotechnology.

### b) Objectives

1. To publicise facts and figures related to problems in health, agriculture, and environmental degradation and pollution, for which biotechnology offers promising solutions;

2. To provide a platform for the students and teachers of biotechnology, allied subjects and social sciences, to articulate their points of view and nurture them as ambassadors to promote safe and appropriate deployment of biotechnology and its products;

3. To serve as a "think tank" to influence public opinion and Government policy development in India and elsewhere in the area of biotechnology;

4. To collect, edit, print, publish and disseminate scientific material and data in biotechnology and related areas, that are of interest to the society;

5. To promote educational programs and supportive policies for the development of internationally competitive biotechnology curriculum at university and collegiate levels in India; and

6. To do all acts, matters and things as are incidental or conducive to the attainment of the above objects or any one or more of them.

## 3. WAYS AND MEANS OF MEETING AIMS AND OBJECTIVES

The aims and objectives of the FBAE will be met through workshops, symposia, seminars, exhibitions, and publication of articles, policy papers, a magazine for students and teachers, and other documents, as well as through mass media.


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|---|---|
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# THE FIRST YEAR
# OF THE
# FOUNDATION FOR BIOTECHNOLOGY AWARENESS AND EDUCATION

FIRST ANNUAL REPORT

## INAUGURATION OF THE FBAE AND THE INAUGURAL WORKSHOP

The formation of the Foundation for Biotechnology Awareness and Education (FBAE) was announced at a Press Conference, held at the Presidential Lounge, Century Club, Bangalore, on January 16, 2001, at 4.00 p.m. Dr S Shantharam, International Food Policy Research Institute, Washington, and Dr C Kameswara Rao, Executive Secretary of the FBAE, explained the need, goals and objectives of the Foundation. Attended by representatives of both the English and the vernacular press, the matter received wide publicity.

The FBAE was inaugurated at 10.00 a.m., on January 18, 2001, at the Conference Hall, Institute of Wood Science and Technology, Malleswaram, Bangalore 560 003, followed by a one-day Inaugural Workshop (11.00 a.m. to 6.00 p.m.). More than 250 persons, mostly students and teachers of microbiology, biotechnology and related subjects, participated in the day's proceedings. Several laymen were also among the audience.
The event was widely covered by the print and visual media.

Professor G Padmanabhan, Emeritus Professor, Indian Institute of Science Bangalore inaugurated the FBAE. Dr S Shantharam Presided.

Dr C Kameswara Rao, Executive Secretary, FBAE, introduced the Policy Document of the Foundation, detailing its goals and objectives. He pointed out that wide spread misconceptions and baseless fears that have dragged biotechnology into needless controversies. He expressed the serious concern of the FBAE regarding a) the lack of an internationally competent curriculum, b) the absence of academically qualified teachers, and the very poor infrastructure in institutions teaching biotechnology courses, and c) the lack of laboratory facilities to train research workers and to conduct research, in the country in general, and the state of Karnataka in particular. He proposed that the Government of Karnataka should establish a central instrumentation facility where students can get trained and research workers can get instrumentation services, on payment of prescribed charges, so that very expensive facilities required for most biotechnological work need not be duplicated. He stressed the need for a Biotechnology Council of India, an Indian standards setting body with authority, on the lines of the Medical Council of India, Dental Council of India, Pharmacy Council of India, All India Council for Technical Education and the Bar Council of India. Such a body will ensure basic minimum standards for providing education and training in biotechnology and will also grant recognition for those institutions that meet such standards. The standards need to be set for qualified and trained teaching staff, infrastructure, adequately equipped laboratories, etc. that are essential for a meaningful education in biotechnology.

Professor Padmanabhan, while inaugurating the FBAE, said that a foundation like FBAE was overdue. He gave detailed instances where scientists have kept silent in the face of onslaught on biotechnology and its applications. He emphasized that the scientists should educate the media and the public to dispel baseless fears hindering a wider application of biotechnology, and hoped that the FBAE will perform this function. Professor Padmanabhan suggested that botany and zoology should be integrated in to Life Sciences to ensure that knowledge from both sciences can be used in a meaningful way.

Dr S Shantharam, in his Presidential address, felt that there is no need for new biotech institutions, while the existing institutions are in great need of financial inputs to perform even minimally. He stressed the need for sufficient governmental funding to make the curricula, faculty and laboratory facilities to offer internationally competitive educational programs. The

Government should start small business grant initiatives in the form of venture capital to encourage young entrepreneurs. He highlighted the role of FBAE in championing a safe deployment of biotechnology in Karnataka and the country. Dr Shantharam emphasized the need to educate the public and the media and considered that an informed student community will function as the best ambassadors of biotechnology and would help in removing the misconceptions and baseless fears regarding the perils of biotechnology from the public mind.

The following spoke, on the subjects mentioned, in the technical sessions that followed the inauguration:

Public perception of biotechnology: Dr S Shantharam
Transgenic crops for pest management: Dr T M Manjunath
Biotechnology and agribusiness: Dr Sharan Angadi
Biotechnology in tree improvement: Dr T S Rathore
Current trends in bioinformatics: Dr Nagasuma Chandra
Bioinformatics and access to genomics: Dr M N Jagadish
Challenges to teaching biotechnology: Shri M N Venkatesh

Drs. S Shantharam, T M Manjunath, Sharan Angadi, Shanker Bhat Sullia and G Sivakumarswamy, conducted a panel discussion covering various issues of biotechnology. which was enriched by input from the audience.

The following major recommendations have emanated from the day's deliberations:

1. The Foundation should organize workshops and meetings on various aspects of biotechnology and related issues, to increase awareness among the public, students, teachers and more particularly the media.

2. Efforts should be made to bring in a reasonably uniform and internationally competent curriculum at the undergraduate and postgraduate levels.

3. The Government of Karnataka should be persuaded to establish a biotechnology instrumentation center, to help students to get training and research workers to avail the facility on payment of reasonable charge.

4. The Government of India should be impressed upon the need to establish Biotechnology Council of India, in order to regulate and maintain high standards in biotechnology education and training.

## REGISTRATION AND OTHER FORMALITIES

The FBAE was duly Registered under the Karnataka State Societies Act. The Registered Office of the FBAE is located at No 1, Gupta's Layout, Southend Road, Bangalore 560 004.

Other formalities such as bank account, submitting an application for the PAN allocation by the Income Tax Department have been put in place.

## OFFICE BEARERS

The following were nominated as Office Bearers of the FBAE, on the eve of Registration and submission of the Memorandum of Understanding: Dr Gurumurti Natarajan, Chennai (President), Dr Sharan Angadi, Bangalore (Vice President), Dr C Kameswara Rao, Bangalore (Executive Secretary) and Mr M N Venkatesh, Bangalore (Treasurer).

## MILLENNIUM BIOTECH POLICY OF THE KARNATAKA STATE

The Government of Karnataka has released the Millennium Biotech Policy. Although this is among the best of such policies by any State Government, there are certain issues to be addressed.

The Federation of Karnataka Chambers of Commerce and Industry (FKCCI), who also were disturbed at the lack of focus on agriculture, have proposed to twin with the FBAE to pursue the matter further. The FKCCI nominated the Executive Secretary as the Vice Chairman of their Committee for Agriculture, Horticulture and Biotechnology. Following several meetings, the Committee came out with recommendations on agricultural biotechnology and related areas, and submitted them to the Minister for Agriculture and the Minister for Horticulture, Government of Karnataka, at meetings convened on the premises of the FKCCI. A copy of these recommendations is included in this volume.

## BIOTECHNOLOGY COUNCIL OF INDIA

The FBAE had discussions with several students and teachers of the undergraduate and postgraduate courses in biotechnology to assess the situation. Basing on these discussions and the recommendations adopted at the Inaugural Workshop of the FBAE, letters were addressed to the Department of Biotechnology DBT), Government of India, to constitute a Biotechnology Council of India. A copy of the letter submitted to the DBT is included in this volume. The DBT has accepted the proposal in principle and is placing it before its expert bodies for approval.

## STAKEHOLDERS' DIALOGUE ON SUSTAINABLE AGRICULTURE

The President and the Executive Secretary submitted up a contractual proposal to conduct Stakeholders' Dialogue meetings on Sustainable Agriculture, for Syngenta International AG, through Syngenta India. The FBAE's proposal was accepted by Syngenta India, in the face of competition.

Meetings of Stakeholders were conducted at Delhi (October 29, 2001), Hyderabad (October 31, 2001) and Pune (November, 2, 2001). About 60 well-known experts in the field of agriculture, economics, sociology, farmers' leaders and media personnel, from different parts of India participated in these meetings. A detailed report on the discussions held and the recommendations made, at these three meetings, was submitted to and accepted by Syngenta. Under the contractual obligation, the report remains confidential, till such time Syngenta evaluates the outcome and release the report.

## MEETINGS AND WORKSHOPS CONDUCTED BY THE FBAE

The FBAE conducted a half-day lecture meeting on October 13, 2001, at the Auditorium of the NMKRV College for Women, Jayanagar, Bangalore, where Dr T M Manjunath spoke on the Role of Biotechnology in Agriculture and Dr C Kameswara Rao spoke on Golden Rice. About 250 students and teachers attended the meeting.

A one-day workshop on Biotechnology Awareness was conducted on December 8, 2001, jointly with the SSMRV College, JP Nagar, Bangalore. In the session on Agricultural Biotechnology, Dr K S Mohan (Bt technology), Dr P H Ramanjini Gowda (Novel compounds from plants through biotechnology) and Dr C Kameswara Rao (Golden Rice) spoke. In the session on Bioinformatics, Dr H G Nagendra gave an over-view of Bioinformatics while Dr Santanu Dasgupta spoke on Functional Genomics of Plants. Dr R Raghu gave a demonstration lecture on Drug Designing through Bioinformatics. This was followed by an interaction of the audience and the experts. Compiled Reading Material of about 70 pages and Certificates were distributed to about 300 participants. This workshop was covered extensively in an article on Bioinformatics in Deccan Herald subsequently.

A one-day workshop focusing Bioterrorism is being organised for January 28, 2002, at the Auditorium of the SSMRV College, to mark the Annual Day of the FBAE.

## DISTRIBUTION OF MATERIAL TO EDUCATIONAL INSTITUTIONS

The FBAE received copies of coloured brochures and other informative material from international agencies promoting biotechnology awareness. These were distributed to the Educational Institutions in Bangalore, at the workshop on December 8, 2001 and others who are interested in the issues.

## FBAE WEBSITE

The Website of the FBAE is finally in place, with the efforts of the Webmaster Shri D. Srinath. The domain name is <fbae.org>.

## CONTRIBUTION TO OTHER WEBSITES

The executive Secretary has been closely following the developments in biotechnology the world over. Comments, opinions and scientific factual data have been communicated to websites, when warranted. Such communications have been re-posted on other websites and quoted in journal articles. These posting have also attracted the attention of scientific experts in different parts of the world, and several of these have been corresponding with the FBAE frequently, via e-mail.

## PARTICIPATION IN MEETINGS AND CONFERENCES

The Office bearers have participated in meetings and conferences related to biotechnology organised by other agencies, such as Monsanto's Annual Day conference (Executive Secretary and the Treasurer), two joint National conferences of the CII and FKCCI on Agricultural Processing (Executive Secretary), CII's International Conference at Delhi (President and Executive Secretary), a few others.

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## MILLENNIUM BIOTECH POLICY OF KARNATAKA STATE

We congratulate the Government of Karnataka on formulating an impressive and comprehensive policy document on biotechnology.

On a close examination of the State's policy document, the Foundation for Biotechnology Awareness and Education represents to the State Government, to consider the inclusion of the following, in the State's Biotech Policy.

### A. Agricultural Biotechnology:

a) Establish a high-powered single window statutory body, such as a Risk Analysis and Bio-safety Committee (RABC) consisting of scientific experts, product generators and marketers, to process, within a set time frame, applications for field testing and/or growing genetically modified (GM) crops. The RABC should hold hearings to invite informed public opinion and also function as a regulatory body to identify specific GM crops for field testing and/or growing and to declassify such crops when the situation warrants.

b) Institute a mechanism for providing legal protection to individuals and organisations that wish to conduct field tests and/or raise approved GM crops, declaring violence against individuals and vandalisation of property, as criminal acts attracting the penal provisions of the state.

c) Institute a mechanism to encourage and financially support individual initiative in crop improvement through biotechnology and in developing and marketing promising products through venture capital.
and

d) Provide for the inclusion of at least one agricultural biotechnologist, one person from the agro-biotech industry and one from biotech commerce, in the state's Vision Group on Biotechnology.

### B. Biotechnology education and training:

In order to ensure that we have adequate numbers of trained personnel for our future needs in the area of biotechnology, we should ensure quality in education and training. In view of the alarmingly low standards in the institutions offering biotechnology education in the State, and the lack of adequate and easily accessible facilities for research in biotechnology, the following remedial measures are urgently required:

a) Institute a statutory regulatory body, independent of the Universities and the Government Departments, to stipulate and ensure minimum standards and

requirements of curricula, infrastructure and regular faculty needed for conducting B.Sc., and M.Sc., courses in biotechnology. Such a high powered body, consisting of academicians and biotechnologists, constituted on the lines of the Medical, Dental, Pharmacy, and Bar Councils of India, and the AICTE, will recommend for recognition, continuation of recognition or de-recognition, of educational institutions, periodically. and

b) Establish a Centre for Biotechnology Training and Instrumentation Service, to provide for paid training facilities to students of undergraduate and postgraduate courses. The Centre should also help research workers in biotechnology to avail instrumentation facilities and other services on payment of reasonable charges. Such a provision will prevent an unnecessary duplication of expensive laboratory facilities.

*C Kameswara Rao*
*Executive Secretary, FBAE*

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## ON THE NEED FOR A BIOTECHNOLOGY COUNCIL OF INDIA

The FBAE held a workshop, on Biotechnology Awareness and Education, on January 18, 2001, at Bangalore, where over 250 students and teachers of microbiology and biotechnology, stakeholders, as well as several laymen interested in biotechnology have participated. Subsequently we had discussions with a number of stakeholders in biotechnology. Several of the members of the FBAE have been in the University system for over three decades, and have first hand knowledge and experience in the institution and organization of postgraduate courses in biological sciences, including microbiology and biotechnology. And some of our members are active biotechnologists outside India. Our collective experience compels us to express serious concern and to act on top priority regarding

a) the general lack of a standard and competent curriculum;
b) the absence of academically qualified and regularly appointed teachers, and the very poor infrastructure in institutions teaching UG and PG courses in biotechnology; and
c) the lack of laboratory facilities to train research workers and to conduct research, in the country in general, and the state of Karnataka in particular.

1. In view of this depressing situation which threatens to soon seriously defeat the national effort to derive benefits from biotechnology, we stress the need to put in place a Biotechnology Council of India (BCI), an independent statutory national body, on the lines of the Medical Council of India, Dental Council of India, Pharmacy Council of India, All India Council for Technical Education and the Bar Council of India. The main function of such a body would be to ensure basic and minimum standards in biotechnology education and training in the country. The BCI should be empowered to grant recognition for those institutions that meet such standards, set with reference to qualified and trained teaching staff, infrastructure, adequately equipped laboratories, etc., that are essential for a purposeful education in biotechnology. The recent de-recognition of several institutions that did not meet with the minimum requirements, by the Dental, Pharmacy and Bar Councils of India, is an example of the activity, for the functioning of the BCI, when constituted. With vested interests calling the shots, approval/recognition by the Universities and the State Governments has lost its sanctity.

2. We propose that the State Governments and the Department of Biotechnology, with the certainly feasible support from and collaboration with the Industry, establish instrumentation and training centers in a few key locations in different states, where students can get trained and research workers can get instrumentation services, on payment of prescribed charges, so that very expensive facilities required for most of education and training in biotechnology need not be duplicated.

These measures are essential to ensure adequate numbers of properly trained personnel to cater to the manpower needs in biotechnology in the country.

SYNOPSIS OF THE KEYNOTE ADDRESS

# BIOLOGICAL WARFARE: BIOTERROISM

By Lt. Gen. D. Raghunath (Retd.)

Sir Dorabji Tata Centre for Research in Tropical Diseases

History is replete with accounts of pestilences that decimated human populations. Massive outbreaks of plague, cholera, smallpox, influenza, etc. have played major roles in human events. While these catastrophes were generally ascribed to 'evil spirits', wrath of Gods or deserved retribution for evil ways, shrewd observers (even in the Pre Christian era) realised that there were infectious agents responsible. The effectiveness of the outbreaks in causing social paralysis tempted ambitious conquerors to use the infections as military weapons. Probably, the only reason we have no regular record of such actions in ancient history is because the ability to strike at the enemy *alone* was not developed. Nevertheless, there are historical accounts of using diverse noxious biological substances as weapons including such materials as 'faces, dead horses and fleas'[1]. They were not always successful. There is evidence that the attempts were not confined to military action, 'disgruntled' civilians and even some physicians resorted to this modality.

The technological advances in the study of infectious diseases from the latter half of the 19th century has enabled us to use Biological Weapons effectively. The 20th century concept of all-out war encompassed a comprehensive effort aimed at not only the person of the enemy, but also his social, political and economic *milieu.* This has had an effect on the subject. Today the term Biological Warfare covers not only agents aimed at humans but also those that have economic effects by targeting livestock and crops (food or fodder).

Biological Weapons (BW) of mass destruction are usually clubbed with the Nuclear and Chemical weapons in the acronym NBC. However, they (BW) are very different, while nuclear and chemical attacks cause their damage maximally immediately, biological attacks become manifest after some time. Thus, the target may not be aware of the attack when it occurs. The introduction of live pathogens into a population/biological environ often sets up a chain of secondary infections resulting in effects that last beyond the immediate. The ease of production, manipulation and delivery as well as their insidious nature makes them the most feared [2].

The expansion of biotechnology and simplification of procedures has enabled individuals or small groups of *'Committed'* individuals to terrorise society. Despite its innate abhorrence of using diseases as weapons, humanity has not eschewed this mode of warfare. Nevertheless, successive international agreements/protocols have expressed the human desire to eliminate this form of warfare. The Geneva Protocol of 17th June 1925 was a beginning, the 1972 Biological and Toxin Weapons Convention (BWC) was a refinement. BWC is unique in that it expressed the desire to ban an entire weapon class of mass destruction. Nevertheless, Biological Warfare potentials have continued to proliferate. The situation in mid 1990's has been reviewed by Benu Dhawan *etal* [2]. The authors have also referred to BW capability of Iraq, (investigated by UNSCOM) and the much larger organization developed in the former Soviet Union. The latter programme has split up and passed on to the successor states and become accessible to other proliferators."[3]

The major deficiency in the 1972 BWC was the absence of a "protocol establishing a compliance regime with appropriate enforcement measures included". This is in the process of being remedied and an enforcement agency called Organisation for the Prevention of Biological Warfare (OPBW) will become the watchdog.[4] The roll-on text has been discussed threadbare in Geneva and is probably on the threshold of being finalized. The ratification by member states will give effect to the functioning of OPBN.

The US Secretary for Health and Human Services, Donna Shalala, [5] in an article on the preparedness of the United States to face Bioterrorism draws attention to the scenario painted in Richard Preston's book. "The Cobra Event". She also quotes the US President, who while reviewing the implications of the sarin nerve gas attack in the Tokyo subway, stated, "this is not a cause for panic. It is a cause for serious, deliberate long term concern".

These observations hold good for all countries. Essentially, the response to the challenge can be organised at four levels. These are: spreading the **awareness, enhancing the medical and public health response, research on agents and development of rapid diagnostics, drugs and vaccines and International collaboration.** Biological warfare or terrorism uses agents that do not respect "boundaries of culture, language or territory". Thus, to quote Dr. Gro Brundtland, Director- General of WHO, "Solutions, like the problems have to be global".

Addressing a gathering of medical microbiologists this author reminded them that though Biological Warfare deviates from the basic ethic of the medical profession, the agents are products of their speciality. Thus, they would be the focal points of the action for prevention or minimizing the impact of this mode of warfare. This responsibility should ensure their 'place in the sun'.

India has not developed any BW capability and is rather naive in this respect. It is a large country with diverse population groups, different aspirations and ethnic affinities. The basic microbial technology is well developed in the country and a large pool of trained workers are available. Bioterrorism is a definite hazard the health administrators have to consider. Dhawan *etal*[2] have dwelt on this. A point to be borne in mind is that there would be a freeze on facilities perceived (by international inspectors) to be useful in tackling BW and deficiencies existing at the time of promulgation of OPBW would be made good by countries that have the facilities in place – a situation not acceptable to any sovereign state. Therefore, there is a sense of urgency in developing our BW/Bioterrorism combating capabilities.

In all circumstances it appears that Anthrax, Smallpox and Plague would be most lethal agents that can be employed. National preparedness to combat these three are in consideration and we hopefully be soon in place.

The possible agents for Biological Warfare/Bioterrorism with infective dose and characteristics are reproduced in Table – 1.

## Table I. Probable agents of biological warfare

| Agent | Infective dose (aerosol) | Incubation period | Diagnostic samples | Diagnostic assay |
|---|---|---|---|---|
| Smallpox | Assumed low (10-100 organisms) | 7-17 days | Pharyngeal swab, scalp material(BSL 4) | ELISA, PCR, virus isolation |
| Anthrax | 8000-50000 | 1-5 days | Blood (BSL 2) | Gram stain, Antigen-ELISA, Serology-ELISA |
| Plague | 100-500 organisms | 2-3 days | Blood, sputum, lymph node aspirate (BSL 2/3) | Gram or Wright-Giemsa stain Antigen-ELISA, Immunofluorescent assay |
| Botulism | 0.001μg/kg (type A) | 1-5 days | Nasal swab (possibly) (BSL 2) | Antigen-ELISA, Mouse neutral |
| Viral | 10-100 organisms | Venezuelan EE | Serum, Venezuelan | Virus isolation |
| encephalitides | | 2-6 days; Eastern EE/Western EE 7-14 days | EE (BSL), Eastern EE (BSL2), Western EE (BSL2) | Serology-ELISA haemagglutination inhibition |
| Viral | 1-10 organisms | 4-21 days | Serum, Venezuelan Ebola, Marburg, Argentine HF, Congo-Crimena HF, Bolivian HF, Lassa fever (BSL 4), For Rift Valley fever, Korean HF, Yellow fever (BSL3) | Virus isolation, Antigen-ELISA Reverse Transcriptase-PCR serology-Antibody ELISA |
| Brucellosis | 10-100 organisms | 5-60 days, occasionally months | Blood, bone marrow, acute and convalescent sera (BSL3) | Serology-agglutination culture |
| Q fever | 1-10 organisms | 10-40 days | Serum (BSL 2/3) | Serology-ELISA, Immunofluorescent assay |
| Tularemia | 10-50 organisms | 2-10 days | Blood, sputum, serum, electron microscopy of tissue (BSL 2/3) | Culture Serology-agglutination |
| Staphylococcal | 30 ng/person (incapacitating) 1.7 ug/person (lethal) | 1-6 hours | Nasal swab, serum, urine (BSL2) | Antigen-ELISA Serology-Antibody ELISA |

Modified from Franz *et al* (JAMA 1997,**278**,394-411)

Abbreviations:
BSL biosafety level ELISA enzyme-linked immunosorbent assay PCR polymerase chain reaction
EEequine encephalitis HF haemorrhagic fever

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# BIOTERRORISM: EFFORTS AND PREPAREDNESS

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Bioterrorism is a disease of human progress and those who speak for the microorganism may also be responsible for various episodes. Biological and Toxins Weapons Convention (1972) adopted in 1975 prohibits the development, production and stockpiling or transfer of biological agents (pathogens and toxins) for other than peaceful purposes and any devise used to deliver these agents for mass destruction. In this convention it was also decided that if there is any non-compliance by any state, one may submit a complaint to UN Security Council. There are several accounts of non-compliance and non-cooperation of the treaty has been in force. Recent information about biological weapons programs of former Soviet Union, Iraq and suspected biological warfare used by USA in Korea and China gave further momentum to verification efforts. A draft protocol (>200 pages text) to the Biological and Toxins Weapons Convention is in final stage of development for signature and ratification. This protocol debate mechanism for investigating certain outbreaks of suspicious diseases as a result of bioterrorist activity.

The potential spectrum of Bioterrorism ranges from hoaxes, use of non-mass casualty devices or of mass destruction by an individual or small groups of people (cult) or it may be state sponsored that employs classical biological warfare agents. Agents of anthrax, human, plague, brucellosis, small pox, viral encephalitis, viral hemorrhagic fever, influenza are relatively easy to produce.

Although control of bioterrorium is difficult task because of large number of disease organisms can be used by great diversity in social, political, geographical and environmental issues. We have the power to push bioterrorim off the globe but only if the governments, World Health Organization, scientists, epidemiologists, researchers, private sectors and public work together having global strategy with assumption that it would happen any time, any where, any place on this planet if we are not vigilant. To combat bioterrorism India is upgrading SOPs involving various institution (HSADL, DRDO, DMSRDE) Some of these issues will be discussed and illustrated by classical examples of Smallpox and anthrax cases in USA.

# POTENTIAL OF INTRODUCED PESTS AS WEAPONS OF BIOTERRORISM

**Professor Puttaswamy**
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In the past ten years at least six species of insect and mite pests have invaded India affecting agricultural production. Large scale movement of plant material such as vegetables, fruits, ornamentals, planting material, seeds, etc., and agricultural commodities between countries entails the danger of accidental introduction of insect and mite pests, nematodes, pathogens and weeds. The problems due to accidental introduction of pests are manifold as the pests find new breeding ground that is conducive for their establishment, without any restriction whatsoever, of the natural regulating factors such as natural enemies that keep them under check in their native range. Their dominance in the new found habitat would cause immense damage to native fauna and flora thus upsetting the natural ecosystem of the invaded habitat.

Some of the recent invasive pests in India are the Psyllid, *Heteropsylla cubana* (Crawford) on *Lucaena leucocephala*; American serpentine leaf miner, *Lirimyza trifolii* (Gurgess) on a number of vegetables and ornamental plants; coffee berry borer, *Hypothenemus hampei* (Ferrari) on coffee; Spiralling whitefly, *Aleurodicus dispersus* (Russell) on a number of agricultural and horticultural crops and forest trees; Silver leaf whitefly, *Bemisia argentifolii* (Bellows and Perring) on a number of vegetables and Coconut mite, *Aceria guerreronis* (Keifer) on coconut. Outbreaks of cocunut mite and silver leaf whitefly had devastating effect on the economy of the farming communities in south India, who solely depend upon the crops affected by these pests.

Some of these pests, if internationally introduced by unscrupulous persons, may result in a severe constraint on the economy of that region. Though these instances are rare, there is a possibility of exploitation of some key pests by the interested parties to adversely affect the economy of the region, which they aim to destabilise.

# ARE OUR DEFENCES AGAINST BIOTERRORISM ADEQUATE?

*C KAMESWARA RAO*

**Bioterrorism:** Bioterrorism employs biological weapons to inflict damage on human populations, livestock and the environment. It is largely a matter of microbiology, principally involving the use of micro-organisms and/or their toxins.

Determined bioterrorists with support from like-minded people with basic capabilities in handling micro-organisms can easily get into the production of biological arsenal by accessing into an enormous range of infectious agents and toxins. When the terrorist groups are technically and/or financially supported by regimes of rogue states, the potential to cause damage immensely increases. In every part of the world, civilian populations are highly susceptible to bioterrorism, to some degree or the other.

**Perception of risk:** The state of perception of risk is an important aspect. Developed countries are more conscious of anthrax, botulism, pneumonic plague, tularaemia and smallpox. A lot of information has been pouring into websites on these diseases, their potential risks and the precautions to be taken, in the unfortunate event. However, there is not much concern about the diarrhoeal diseases caused by several viruses and bacteria, which can be used as bioweapons. The website of Medscape and even the official US website of the Centres for Disease Control and Prevention, do not contain any information on diarrhoeal diseases, which can cause immense damage in the developing countries, more particularly among the poorer sections of the population. Poverty, ignorance, high population density and low levels of hygiene in the developing countries, coupled with incompetence and apathy on the part of public and medical authorities, make such diseases as cholera, pneumonic plague, tularaemia, smallpox, haemorrhagic viral infections and other contagious diseases, effective weapons in the arsenal of a bioterrorist targeting the developing countries.

Extensive economic damage can be inflicted through the introduction of animal and plant diseases or pests into the livestock and crops.

Introduced exotic plant species can become gregarious weeds and disturb the balance of the composition of natural vegetation. A recent such example is *Parthenium hysterophorus* that has been dominant for three decades in India. Another example is *Chromolaena odorata,* which colonises gregariously, the moment a patch of forest becomes open, in the Western Ghats. However, the impact of weeds is slow and can be contained, particularly when detected early. It is also possible to discover an economic use for such species to convert the situation to advantage.

**Dual potential of biotechnology:** Biotechnology is a potential means to combat the danger of bioterrorism, through the production of diagnostics, drugs and vaccines against bioweapons and/or their source organisms. Nevertheless, it can also be a source of bioweapons. Weaponised agents produced through biotechnological means, not yet realised, are a long-term possibility. New pathogenic organisms can be created using genetic tools that are programmed to trigger replication or toxin production in response to an environmental chemical, such as an antibiotic in drinking water. The research that is now trying to understand what makes an organism pathogenic is aimed at designing more efficient drugs. Such knowledge can also be used to create pathogenicity in hitherto non-pathogenic organisms or to increase the existing pathogenic potential of an organism,

posing enhanced threats, from bioterrorism. Nevertheless, research into these aspects should be adequately funded, in spite of the risks involved, for the outweighing advantages.

**Race between the pathogen and the pathologist:** An unfortunate situation is that biological defences through vaccines and drugs, will in the course of time, be defeated by an inherent biological factor. The efficacy of a drug against an organism is short lived, as pathogens acquire resistance, sooner or later, against the once effective drug. Recurrence of malaria and tuberculosis, thought to have been contained, is the case in point. There are very serious fears of recurrence of smallpox, believed to have been eliminated over two decades ago. No amount of technical advancement will provide defence against the compelling evolutionary component of acquired resistance. It is an eternal race between the pathogen and the pathologist, the former being a little ahead of the latter, most of the time.

**Measures to control production of bioweapons:** In an Editorial in Nature Biotechnology (19:993, November 2001), three approaches were suggested to control the production of bioweapons:

1. Deterrence: The Biological and Toxin Weapon Convention (BTWC) is in obscurity. Resurrecting the BTWC and persuading more nations to sign in will facilitate inspection by UN Inspectors, of sites and facilities suspected to be involved in the production of biological weapons. It was the UN Inspectors who stumbled upon the tell tale signs of production of biological weapons in Iraq. UN can ensure compliance of member countries with their obligations to the BTWC, under the Verification Regime. Such inspections facilitate stopping errant countries before they go too far. The counties that refuse to sign into the BTWC should be subjected to extreme and frequent scrutiny, under the other powers of the UN.

2. Restricting accessibility: Currently, it is not difficult to obtain, or to redistribute, strains of pathogenic bacteria and viruses from the repositories, under pretences of research and drug development. Accessibility to, and security of, biological material that can be employed in bioterrorism should be tightened. Recipients of such material should be prohibited from redistributing it to unauthorised third parties. Though easier said than done, this is a very important preventive measure and will also help in fixing responsibilities.

3. Regulation of technology transfer: Transfer of dual-purpose technologies (those that can be used in developing protective measures against the disease and also as bioweapons) should be under strict watch. Transfer of such technology to suspect groups and/or regimes, as well as a subsequent deployment to unauthorised parties, should be prohibited. Iran is believed to have obtained recombinant technology from Cuba. Companies in the US, Europe and the erstwhile USSR are supposed to have provided materials used by Iraq for her biowarfare programme.

**Preparedness to face bioterrorism:** In no part of the world, the public health and medical authorities are adequately geared up to detect and respond to biological hazards, natural or inflicted by bioterrorists. Almost all the developing countries are virtually totally unprepared against bioterrorism. There is a lack of scientific awareness, preparedness and funding. Stocks of antibiotics and vaccines against known pathogens that are essentially needed are inadequate to meet with even the periodical natural high incidence, let alone in the event of a bioterrorist attack. The situation is worse in the developing countries. The havoc caused by the plague epidemic that caught everyone napping, in Surat in India a few years ago, is a recent example.

The degree of damage an organism or a toxin can inflict varies widely and this also depends upon the socio-economic status of the country or sections of her vulnerable population. Although anthrax is much in the news currently, it is a poor biological weapon and can cause only a localised

damage, as it is primarily not a prevalent human disease and it is not contagious. Diseases that spread through food and water (or by human contact) cause a far greater damage among the poorer sections of the population of any country.

Some aspects of preparedness against bioterrorism are similar to those needed to face natural disasters like cyclones, floods and earthquakes, as epidemics often follow such disasters. We should act in advance and not after the disaster strikes, as we usually do. Some urgent measures in this regard are:

1. Public awareness: It is reasonable to expect that the bioterrorist would choose a particular disease for use in a particular country, and may even target a particular segment of the population of that country. For example, a human pathogen can be transmitted through susceptible or carrier bovine hosts to affect beef eaters. People can be affected by the New Variant of Creutzfeldt-Jacob's Disease (nvCJD), a prion disease, on consumption of food contaminated with the mad cow disease (Bovine Spongiform Encephalopathy). Public health and medical authorities should identify the probable diseases and the means of their spread, and make the public aware of these possibilities. Public should also be made aware of the precautionary measures to be taken and the methods of management of the diseases, when they appear. Facts about different diseases of bioterrorist import should be publicised, the way Centres for Disease Control and Prevention in US do. All this is not a small task in countries with large illiterate populations but an infrastructure to achieve this must be built up, without loss of time.

2. Research and Development: We need adequate number of well equipped labs with facilities for microbiologists to develop quick and certain means to identify the pathogen and the disease, for biochemists to develop diagnostic kits, for pharmacologists to develop drugs and for immunologists to produce vaccines. In every country there is some activity of this nature but it is not adequate.

3. Stockpiling vaccines and drugs: We need very large stocks of vaccines and drugs for different diseases in times of disaster. Authorities should identify the vaccines and drugs that would be required to meet the eventuality and advice the manufacturing units to produce the required quantities. Care should be taken that the drug manufacturers do not exploit the situation by hiking the prices, as seems to have happened with anti-anthrax drugs recently.

4. Contingency plan of action: Authorities should draw contingency plans of action, separately for each vulnerable area, to meet with the situation when it develops, and identify the hospitals, health care units, doctors and para-medical personnel and prepare them to face the situation.

**Problems of logistics:** There are practical difficulties. Stockpiling antibiotics and other drugs, against all the potential weapons of bioterrorism, in quantities adequate to protect the susceptible human populations and livestock, is an unimaginably immense and nearly impossible task, not to speak of the expenditure involved, even in the developed countries. 'How much and of what?' is a question that cannot be answered with confidence.

**Biodefence research and preparedness:** In our efforts of building defences against bioterrorism we can never anticipate all possibilities. It would be naïve to think that any amount of investment in biodefence research will protect us in the long term against bioterrorism, which is almost always a random act of calculated savagery, often from a hidden insidious enemy, as is the case with any form of terrorism.

Preparedness, more so advertised preparedness, minimises the risks, particularly because a bioterrorist attack is futile in the face of defence. It is extremely unlikely that anthrax would be used in US again.

Biodefence research must continue both to provide improved drugs and protective measures to deal with normal illness, as well as to prepare us to face a bioterrorist attack. One may argue that we should expect the unexpected, but that is not always possible, and certainly not all the time, and not forever. We should not forget that the degree of success of a terrorist attack lies in the element of surprise, in terms of the place, manner and the time of the attack. Almost certainly, there will be no bioterrorist attack where and when we are prepared.

**Potential role of indigenous systems of medicine:** In countries like India and China, the indigenous systems of medicine have a number of plant based drugs effective against several infectious diseases that can be a means of bioterrorism. For many there are clinical data in support of their efficacy. A lot of damage can be contained if the probable diseases are identified and the precautionary and remedial measures from the indigenous systems of medicine are publicised. For example, the yellow sheets in the pomegranate fruit (other than the outer leathery covering and the seeds) contain a principle that is effective against a broad range of gastrointestinal pathogens, including the cholera bacterium. Dried and powdered, this material is traditionally administered in buttermilk or even water, to control diarrhoeal infections. Oral rehydration solution that saves the lives of millions of children suffering from diarrhoea can also prevent dehydration in adults. Countries that cannot afford modern approaches, in terms of the expertise, infrastructure, time and money involved, better find solution to the problem, from within the local tradition.

The models of research and defence measures of the advanced countries cannot be directly imported into the developing countries, as the strains of pathogens, their severity, the susceptibility of the populations to a particular disease, and the affordability of the costs involved, are all different. In the efforts of each country to develop her own defences, indigenous systems of medicine come in here very handy.

The advantages of indigenous systems are accessibility, economic viability and reasonable effectiveness, in terms of both prevention and management of infectious diseases, with a local import.

**Should biodefence preparedness be public knowledge?**

A question that is raised often is, 'whether it is wise to make the biodefence strategy and state of preparedness public knowledge?' It is felt that the bioterrorist also gets to know of the detailed plans and defences built up and would act bypassing them. There are at least three considerations in favour of transparency. Firstly, biodefence is aimed at facing a bioterrorist attack, but preventing this is the better choice. Well-advertised preparedness against the best arsenal of a bioterrorist would be a deterrent. We are fighting bioterrorism and not the bioterrorist. Secondly, if the public come to know of what the governments and other agencies have been doing for their safety, their confidence in our public institutions, which is a very important psychological factor, would grow. Thirdly, awareness of the governmental efforts may inspire private organisations and individuals to add their own bit to the national effort. Upon these considerations, it is not wise to keep biodefence strategy under the warp, on the grounds that military strategy, which is an entirely different issue, is a closely guarded secret.

# PREPARATION TO FACE BIOTERRORISM

C KAMESWARA RAO

India is among the most vulnerable countries that run the risk of facing threats of bio
A lot of R&D and groundwork has to be planned and carried out speedily, for the vulne
countries to offer even a semblance of fight against bioterrorism. In the current absence
awareness and preparedness, we need to examine what the developed world has been do
face bioterrorism.

A number of recommendations, based on a very comprehensive survey, to deal with chemi
and biological terrorism and to increase civilian medical response, appeared in the publica
"Improving Civilian Medical Response to Chemical or Biological Terrorist Incidents: Int
Report on Current Capabilities (1998)". This report was prepared by the Committee on R
Needs for Improving Civilian Medical Response to Chemical and Biological Terrorism
Incidents, Division of Health Science Policy, Institute of Medicine, Board on Environmen
Studies and Toxicology, National Research Council, in the US. While we cannot directly
import the western models, which are aimed at improving an existing and reasonably effe
preparedness. they will certainly help in planning our own strategies, basing on our grou
realities. A summary of the 10 R&D needs and eight recommendations from this report is
here. Developing countries do not have the organisational infrastructure basis comparable
that in North America or Europe (mentioned in here), although there are some governmen
non-governmental organisations, involved in R&D in public health, drug development and
medical issues. These efforts need to be upgraded to suit each country's requirements to fa
bioterrorism and/or natural calamities.

The R&D needs and recommendations presented here may seem to be simple at the first g
but they are loaded with prescription for extensive and expensive work, on several fronts
simultaneously and each one of the 18 statements requires an elaborate explanation to put
action. They would do a lot of good to gear up the potential of a country to manage disea
its day-to-day occurrence and prepare as never before to face natural calamities such as
cyclones, floods and earthquakes, which epidemics follow in the wake.

## Research and Development Needs

1. A system is needed to ensure that medical facilities receive information on actual
suspected, and potential terrorist activity. Research may be necessary to determine
should be communicated, to whom it should be communicated and even whether
system should vary by state and city, but it must include links to the law enforcem
community.

2. The civilian medical community must find ways to adapt the many new and emer
detection technologies to the spectrum of chemical and biological warfare agents
responders, emergency medical personnel, and public safety officials, all need
instrumentation for detecting and identifying chemical and biological agents in
environment and in clinical samples from patients. The watchwords are simplici
speed, cost, sensitivity and specificity. The key to widespread purchase and use
with identifying a wide spectrum of toxic substances, including but not limited to
military agents.

3. Work on symptom-based tools for identifying unknown toxic agents, including but not limited to, military chemical weapons, is an area where benefits may extend well beyond response to terrorist acts.

4. Complete information is needed on the toxicity and adverse health effects that could result from acute exposure to low levels of agents, especially in sensitive populations, such as the young, the elderly and those in ill health. This information is necessary to develop guidelines (for example, susceptible human exposure levels) for safe and effective evacuation, decontamination, and other protective action.

5. Methods are needed for rapid, effective, and inexpensive decontamination of large groups of personnel, equipment and environment.

6. Approaches to treatment are needed that have utility beyond terrorism or chemical and biological warfare. Vaccines, or drugs aimed at families of pathogens or toxins, substances to bind toxic molecules before they reach their site of action and perhaps even existing drugs and other chemicals that can serve as expedient treatment (for example, anticholinergics other than atropine), are to be identified.

7. Complete information is needed on possible interactions of antidotes and therapeutic drugs with anti-hypertensives, psychotherapeutics, anti-inflammatory compounds, immunosuppressants, and other medications in widespread public use.

8. There is a need for evaluation of interventions for preventing or ameliorating adverse psychological effects in emergency workers, victims, and near-victims. Examination of the Japanese experience following the release of sarin on the Tokyo subway, other acts of terrorism (recent threat of anthrax in the US), and unintentional releases of toxic chemicals (the Bhopal gas tragedy) would be especially valuable.

9. Information is needed on risk assessment/threat perception by individuals and groups, and on risk communication by public officials, especially the roles of both the mass media and the Internet in the transmission of anxiety (or confidence). Some information is available of pollutants and toxic waste, but there is little or no systematically collected data on fears and anxieties related to the possibility of purpose fully introduced disease.

10. Standardised protocols for follow-up of first responders, healthcare providers and victims are required, for improving care of those individuals, for improving medical response to future incidents, and for improving risk assessments.

**Interim Recommendations**

The Committee considered it irresponsible to focus solely on technology R&D that requires elaborate and meticulous planning and is both time consuming and expensive. Hence, the Committee made eight recommendations involving potentially simpler, faster or less expensive mechanisms than R&D of new technology. These are slightly modified here for the use of the Developing Countries, which should make a beginning with these recommendations and also take up the R&D measures, simultaneously.

1. Provide financial support for improvements in state and local surveillance infrastructure, such as poison control centres and communicable disease programmes.

2. Survey major metropolitan hospitals for supplies of antidotes, drugs, ventilators, personal protective equipment, decontamination capacity, mass-casualty planning and training, isolation rooms for infectious disease, and familiarity of staff with the effects and treatment of chemical and biological weapons.

3. Encourage the governmental and private agencies engaged in health and medical R&D to share their information on diseases and drugs and on the location and owners of dangerous biological materials. State health departments in turn should be encouraged, by education or training, on the effects of agents and medical responses required, to add infections by these materials to their lists of reportable diseases.

4. Provide support to the Army's efforts to test commercial personal protective equipment for protection against nerve and vesicants.

5. Convene discussions among the appropriate agencies on the use of investigational products in mass-casualty situation and on acceptable proof of efficacy for products where clinical trials are not ethical or are otherwise impossible.

6. Develop incentives for hospitals, both public and private, to be ambulance receiving hospitals, to stockpile nerve-agent antidotes and selected antitoxins and put them in the hands of first responders, by changing laws if needed, to purchase appropriate personal protective equipment and expandable decontamination facilities and train emergency department personnel in their use.

7. Provide for state and central training initiatives with a programme to incorporate existing information on possible chemical and biological terror agents and their treatment into the manuals and reference libraries of first responders, emergency departments and poison control centres. Professional societies and journal publishers should be recruited to help in this effort.

8. Intensify Public Health Service efforts to organise and equip Urban Medical Strike Teams, in high-risk cities throughout the country. Although these teams are to be primarily designed to cope up with terrorism, using local personnel and resources, they also increase the community's general ability to cope with industrial accidents and other mass-casualty events.

**Related titles:**


1. Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response. 1999. Committee on R&D Needs for Improving Civilian Medical Response to Chemical and Biological Terrorism Incidents. Institute of Medicine, US, National Academy Press.
2. Firepower in the Lab: Automation in the fight against infections, diseases and bioterrorism. 2001. Solt, P Layne, J. Beugeldijk, and C Kumar N. Patel (Eds.). Joseph Henry Press.


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2. http://www.medscape.com/Medscape/features/ResourceCenter/BioTerr/
3. http://books.nap.edu/books/N1000850/html/52/html
4. http://www.cdc.gov/

# BIOTERROR AND BIOSAFETY

- The Hindu, Thursday, November 01, 2001

Sir, - In the opinion column 'Bioterror and biosafety' (Oct. 19), Ms. Vandana Shiva exploits the recent anthrax cases to advance her anti-science agenda. By painting a gloomy scenario against economic freedom, she calls for an isolationist and backward policy for India.

The use of these biological agents by malicious individuals to inflict harm and fear on an innocent public is evil. But for Ms. Shiva to use this unimaginable evil and horror to rail against imaginary ills of recombinant DNA technology, trade liberalisation and patenting system is intellectual chicanery. Her argument is akin to saying that because terrorists used planes and the mail system to cause destruction, we must ban aircraft and the postal system - that is throwing the baby out with the bath water!

Bioterrorists do not need sophisticated recombinant DNA technology to spread germ or fear. Simple microbiology would suffice.

Civilised societies can protect themselves against terror by continued development and dissemination of scientific knowledge. Effective antibiotics to treat anthrax were developed after many years of research and testing. This required a systematic use of scientific knowledge, a patent protection system to stimulate innovation, and a free-market system that rewards such risk- taking - all of which Ms. Shiva despises. The real bioterror plaguing India has to do with poverty. Millions of people die every year by natural, but preventable, causes through diseases such as cholera, malaria, AIDS and TB. These diseases can only be fought through economic progress and development of modern medical systems.

*C.S. Prakash,*
*Tuskegee, U.S.*

*Potential* of adult stem cell culture is immense as the patients own cells are used, thus the problems of immune rejection and ethical issues do not arise.

**LIMITATIONS**

- Adult stem cells *cannot be isolated* for all tissues; example, adult cardiac stem cells & adult pancreatic islets stem cells have not been located.
- Present in *minute quantities* and hence difficult to isolate and purify, and also, their number decreases with age.
- *Not readily available* for immediate medical use as they require time for culturing.
- In case of genetic disorders, the adult stem cells would also contain the *genetic defects.*
- Adult stem cells may have more *genetic abnormalities.*
- Adult stem cells *are not pleuripotent* as they give rise to 3-4 cell types.

**SO, WHAT IS ALL THE HYPE ABOUT?**

Research has revealed the enormous future potential of stem cells, like stem cells that developed into *neurons* could help repair spinal chord or brain injuries due to Parkinson's disease.

Undifferentiated human embryonic stem cells could be guided down the developmental pathway to form *blood cells* to be used in transfusion or transplantation.

Transplantation of embryonic stem cells could help *repair heart muscles* and improve cardiac function following heart attacks and congestive heart failures.

Combination of chemotherapy and stem cell transplant could be used against multiple myeloma (bone marrow cancer).

*Pancreatic islet cell lines* derived from human pleuripotent stem cells could be used in type I diabetes research and ultimately used for transplantation.

**IS IT REALLY AS SIMPLE AS IT SOUNDS?**

Practical application of stem cell research is not a "cake walk". Numerous *technological challenges* remain to realise the potential of stem cell research.

Need for basic research to understand cellular events leading to *cell specialisation* so that pleuripotent stem cells can be directed to form the desired type of tissue.

Before cells can be used for transplantation, the problem of *immune rejection* must be overcome, as the embryonic stem cells would be genetically different from the recipient (this problem is avoided in adult stem cell culture and somatic cell nuclear transfer).

Other than these technological challenges, there have always been *ethical issues* surrounding stem cell research.

FUTURE POTENTIAL

The future of stem cell research is in our hands and it is up to us, whether or not it is utilised to its full potential for the betterment of mankind. To pursue stem cell research would be to give hope to millions, beyond the capability of conventional medicine.

Latest CDC Webcast: Bioterrorism and the Healthcare Epidemiology/Infection Control Team

# Bioterrorism: Some Sources of Information

Regularly updated collection of Medscape's key clinical content.

Read the latest findings about bioterrorism, from recent conferences and other up-to-the-minute resources available on Medscape. red Topic

Anthrax Resource Center
Useful resources and the latest news to keep you up to date on the spread and available treatment for this organism.

Disaster and Trauma Resource Center
Read the latest on emergency resources and helping to care for those affected by terrorist attacks.

Smallpox: The Weapon That Knows No Borders
[Medscape Infectious Diseases]

Implementing a Network for Electronic Surveillance Reporting from Public Health Reference Laboratories
[Emerg Infect Dis]

Can Derm Warfare Fight Germ Warfare?
[Medscape Dermatology]

Uncoupling Bioterrorism: Infectious Diseases Meet Psychiatry
[Medscape Infectious Diseases]

Scourge: The Once and Future Threat of Smallpox
[MedGenMed]n

Inhalational Anthrax: Threat, Clinical Presentation, and Treatment
[J Am Acad Nurse Pract. April 2001;13:164-168]

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[MedGenMed]

Bioterrorism Initiatives: Public Health in Reverse?
[Am J Public Health. Nov 1999;89:1629-1631]

Prescriptions on Bioterrorism Have It Backwards
[BMJ. Apr 29, 2000;320:1211]

Responding to Bioterrorism

## Conference Summaries

Challenges in Infectious Disease: Pneumonia, Influenza, and Biologic Weapons of Terror
National Conference for Nurse Practitioners 2001; November 7-10, 2001; Baltimore, Maryland

Understanding of the Weapons of Chemical/Biological Terrorism Is the Key to Being Prepared
67th Annual Scientific Assembly of the American College of Chest Physicians
November 4-8, 2001; Philadelphia, Pennsylvania

Bioterrorism and War: Ensuring Public Health
American Public Health Association (APHA) 129th Annual Meeting; October 21-25, 2001; Atlanta, Georgia

What's Hot? Anthrax
39th Annual Meeting of the Infectious Diseases Society of America; October 25-28, 2001; San Francisco, California

## Consensus Statements

Anthrax as a Biological Weapon: Medical and Public Health Management
[JAMA. 1999;281:1735-1745]

Smallpox as a Biological Weapon: Medical and Public Health Management
[JAMA. 1999;281:2127-2137]

Plague as a Biological Weapon: Medical and Public Health Management
[JAMA. 2000;283:2281-2290]

Botulinum Toxin as a Biological Weapon: Medical and Public Health Management
[JAMA. 2001;285:1059-1070]

Tularemia as a Biological Weapon: Medical and Public Health Management
[JAMA. 2001;285:2763-2773]

## Related Links

Bioterrorism Information Page
US Food and Drug Administration

Bioterrorism Online CME Course [free]
American Board of Quality Assurance and Utilization Review Physicians

Information About Anthrax and Bioterrorism from *MMWR*
Centers for Disease Control and Prevention

Center for the Study of Bioterrorism
Saint Louis University

Biological and Chemical Terrorism Resources
Nebraska Medical Association

Medical Management of Biological Casualties Handbook
United States Army Medical Research, Institute of Infectious Diseases

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http://www.medscape.com/Medscape/Dermatology/journal/2001/v02.n06/md1115.01.mcgov/md1115.01.mcgov-01.html. <o:p</o:p

# Can Derm Warfare Fight Germ Warfare?

[Medscape Dermatology, 2001. © 2001 Medscape, Inc.] <o:p</o:p
**Thomas W. McGovern, MD** <o:p</o:p

## I Was Wrong

As "man's inhumanity to man" continues to plumb the depths of creative malevolence, we find ourselves at the entrance of the 21st century, living with the specter of biological terrorism delivered to our nation's doorstep. While working in defensive biological warfare research for the United States Army and later teaching at the Army's Medical Defense Against Biological Warfare Course, I was convinced that any bioterrorist attack on American soil would come in the form of an aerosol. Therefore, any cutaneous manifestations of an attack would develop long after systemic symptoms developed. Dermatologists might be helpful in confirming diagnoses, I believed, but not in making them. When thinking about anthrax in particular, I placed *Bacillus anthracis* under the heading "Agents Producing Cutaneous Manifestations Naturally, But Not After Inhalation" in a review article on the cutaneous manifestations of biological threat agents.[1] It didn't cross my mind that bioterrorists would use anthrax in a way that would cause primary cutaneous disease. The events of the last 2 months have proved me decidedly wrong.

## Lessons Learned From Anthrax in the USA — 2001

As of November 9, 2001, 22 cases of anthrax have been identified in the United States, 12 of them cutaneous (7 confirmed, 5 suspected).[2] Eight lesions were biopsied, and all 8 demonstrated *B anthracis* cell-wall antigen by immunohistochemistry (IHC).[2-5] No other serologic or skin test was positive that consistently. Since cutaneous lesions are sterilized after 1 day on antibiotic therapy, skin biopsy for IHC testing is crucial to making the diagnosis of cutaneous anthrax in patients already on antibiotic therapy. Biopsy should also be performed on patients with suspected cutaneous anthrax who are not on antibiotic therapy, because in the New York City index case, a culture and Gram stain of serous fluid was negative but the skin biopsy IHC was reactive.[3] All cutaneous anthrax patients are recovering from their disease.

## Dermatologists as Diagnosticians

With our highly trained eyes and centrally stored pattern-recognition "software," how can dermatologists help diagnose bioterrorist-caused disease? Admittedly, we aren't much help diagnosing inhalational anthrax or botulism toxin exposure. However, out of the 12 Category A high-priority biological agents posing a risk to national security, only botulism toxin and Lassa fever virus do not elicit any cutaneous manifestations.[6] The agents causing anthrax, smallpox, plague, tularemia, Ebola fever, Marburg fever, and the 4 South American viral hemorrhagic fevers (Guanarito, Junin, Machupo, and Sabia) each cause specific cutaneous findings.[1,7]

### Anthrax

Only 224 cases of cutaneous anthrax were diagnosed in the United States between 1944 and 1994[8]; therefore, few US physicians have ever seen a case. Within 1-12 days of exposure (mean = 7 days) to anthrax spores (not live bacilli), a painless, often pruritic, erythematous papule will develop on an exposed area such as the head, neck, or upper extremities. Within 2 days, a vesicle forms that then necroses centrally to form a 1- to 5-cm brown or black eschar. This coal-black lesion gave rise to the name "anthrax" (Greek *anthrakos* =

charcoal). Within 2 days, a vesicle forms that then necroses centrally to form a 1-to 5-cm brown or black eschar. This lesion is often surrounded by a raised, erythematous border, bacilli-laden vesicles, and extensive edema. <o:p</o:p

The most common misdiagnosis is a brown recluse spider bite reaction, which is exquisitely painful. While the primary lesion of anthrax has been called a "malignant pustule," this is a misnomer, because lesions are not purulent unless a secondary infection is present. The eschar usually detaches within 1-2 weeks, leaving minimal scarring. Patients often develop systemic symptoms with tender regional lymphadenopathy, malaise, and fever. Untreated, 10% to 20% of patients will die of systemic disease. Even though lesions are rapidly sterilized by antibiotic therapy, progression through the eschar phase inevitably ensues because skin changes are toxin-mediated. No person-to-person spread of cutaneous (or inhalational) anthrax has ever been documented.

**Smallpox**

Variola, the etiologic agent of smallpox, was eradicated from the human population in late 1977. Unfortunately, smallpox still lingers as a potential biological warfare threat and is maintained in at least 2 laboratories in the United States and Russia. With the dissolution of the Russian biological warfare research program, it is not inconceivable that disgruntled former scientists took biological weapons with them and/or were bought off by other countries to produce weapons for them.

Smallpox was spread by respiratory droplets from the oropharynx of infected persons or by direct contact. Fortunately, the disease rarely spread before the enanthem and rash presented. The most infectious period was from the onset of rash until 7-10 days later.

Following a 7- to 17-day incubation period, a flu-like prodrome lasting 2-4 days ensued, during which 10% of light-skinned patients exhibited an erythematous exanthem. Most patients developed a buccal and pharyngeal enanthem that shed virus and enhanced respiratory transmission. Cutaneous lesions progressed from the face, to the forearms and hands, and finally to the trunk (Figure 3) and lower extremities during a 1-week period. In any 1 anatomic region, all lesions were in the same stage of development. Lesions favored ventral surfaces and began as macules that progressed to papules, vesicles, deeply embedded umbilicated pustules, and crusts. This synchronous progression of centrifugal lesions led to crust formation within 1-2 weeks. The deep crusts would detach after 2-4 weeks, leaving depressed, hypopigmented scars. Although virus could be cultured from crusts throughout convalescence, contact with them rarely led to transmission.

During the first 2-3 days of rash, it may be all but impossible to distinguish between smallpox and chickenpox. Chickenpox lesions are much more superficial and develop in crops, and vesicles, pustules, and crusts may be seen simultaneously on adjacent areas of skin. Moreover, the rash in chickenpox is more dense centripetally over the trunk, and chickenpox lesions are almost never found on the palms or soles.

**Plague**

In nature, most people who contract plague from *Yersinia pestis* develop buboes after being inoculated bya flea bite. While bioterrorists could cause bubonic plague by releasing bacilli-laden human fleas, plague would be much more deadly and transmissible if the bacilli were aerosolized. Buboes present as painful, inflammatory and necrotic lymph nodes, most commonly in the femoral or inguinal nodes. Only 10% of patients present with a bite-site reaction.

Plague pneumonia patients can become septicemic and develop deeply violaceous cyanosis and large ecchymoses, sometimes mimicking meningococcemia. Dark areas of cyanosis, ecchymoses, or acral necrosis probably gave rise to the Medieval epithet "the Black Death."

### Tularemia

Like plague, tularemia would probably be aerosolized by bioterrorists. Pneumonic tularemia has fewer cutaneous manifestations than pneumonic plague because *Y pestis* contains a plasminogen activator and coagulase as well as an endotoxin that can cause disseminated intravascular coagulation. In ulceroglandular tularemia, the most common form found in nature, a heaped-up, juicy, erythematous ulcer is typically found at the bite site, and the draining lymph nodes are tender and inflamed. <o:p</o:p

### Viral Hemorrhagic Fevers

The arenaviruses causing Lassa fever and the South American diseases Guanarito, Junin, Machupo, and Sabia have high rates of morbidity and mortality, although there is now a vaccine against Junin. The thread-like (*filo* = thread) filoviruses cause 2 diseases with high mortality and no vaccines: Ebola and Marburg fevers. All of these viruses are transmissible by aerosol from person to person.

Lassa fever causes an extensive capillary leak syndrome leading to edema without petechiae or hemorrhage. The South American arenaviruses cause petechiae, purpura, ecchymoses, palatal hyperemia, and mucosal hemorrhage.

Marburg and Ebola fever patients frequently exhibit characteristic exanthems noted best in light-skinned patients. Soft- and hard-palate erythema develops after an acute, flu-like syndrome. The most reliable diagnostic sign is a nonpruritic, centripetal, pin-head-sized, papular, erythematous eruption with or without scrotal or labial erythema or dermatitis appearing between days 5 and 7. After 24 hours, this eruption develops into large, well-demarcated, coalescent macules and papules that sometimes hemorrhage. In severe cases, a dark, livid erythema with or without cyanosis develops on the face, trunk, and extremities. Desquamation of the palms, soles, dorsal feet, and extremities follows 1-2 weeks later. Death occurs due to a combination of hemorrhage, capillary leak, shock, and end-organ failure. Mortality rate for Marburg fever is 23%, and for Ebola fever it is 70%.

## Dermatologists as Educators

Because no other physician specialty is as adept at recognizing diseases of the skin, the dermatologist must play an essential role in the diagnosis and treatment of cutaneous anthrax. Indeed, dermatologists made the first 3 diagnoses of cutaneous anthrax in New York City.[9](Personal communication, Mary Wu Chang, MD; Marc Grossman, MD, helped diagnose the sentinel case.)

Since dermatologists only account for 1.5% of physicians in the United States, we must help other specialists and primary care physicians learn how to recognize the cutaneous aspects of bioterrorist-inflicted plagues. The American Academy of Dermatology (AAD) is taking its role very seriously in the effort to combat bioterrorism through early diagnosis and treatment. Within days of the first confirmed case of cutaneous anthrax, AAD president Ronald Wheeland, MD, called for the formation of a Bioterrorism Task Force (BTF) headed by AAD vice president Boni Elewski, MD. With the cooperation of the Centers for Disease Control and Prevention (CDC), the BTF has produced an algorithm for the diagnosis and treatment of potential cutaneous anthrax cases. This algorithm is more detailed than the CDC algorithm[5] and is available now on the Members Only portion of the AAD Web site; links are being created for other physicians via their specialty organization Web sites. This algorithm will also be available soon at http://www.eblue.org/, the Web site of the *Journal of the American Academy of Dermatology*.

The BTF is currently working closely with the CDC to develop 3 smallpox-related algorithms to deal with the diagnosis of a sentinel smallpox case, to diagnose subsequent cases, and to recognize and treat vaccine reactions. The AAD is working through its Advisory Board structure to develop a list of key contacts and educators in every state so that there will be local

experts available to diagnose skin disease related to biological agent attacks.
Many upcoming dermatology meetings will include presentations on bioterrorism, including the annual AAD meeting in New Orleans, Louisiana, in February 2002. The BTF is developing a bioterrorism speakers' bureau that will teach dermatologists as well as other physicians interested in learning more about this timely subject. To assist the speakers, a CD-ROM-based slide presentation is being developed that includes all of the above diseases with up-to-date information and numerous photographs.
Last week, Dr. Wheeland sent a letter to President Bush offering the assistance of dermatologists and outlining what the AAD is doing to aid the country in the event of further bioterrorist acts. We on the BTF clearly believe that "derm warfare can effectively fight germ warfare."

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# FACTS ABOUT ANTHRAX, BOTULISM, PNEUMONIC PLAGUE AND SMALLPOX


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## FACTS ABOUT ANTHRAX

Anthrax is an acute infectious disease caused by the spore-forming bacterium *Bacillus anthracis*. Anthrax most commonly occurs in hoofed mammals and can also infect humans.

Symptoms of disease vary depending on how the disease was contracted, but usually occur within 7 days after exposure. The serious forms of human anthrax are inhalation anthrax, cutaneous anthrax, and intestinal anthrax.

Initial symptoms of inhalation anthrax infection may resemble a common cold. After several days, the symptoms may progress to severe breathing problems and shock. Inhalation anthrax is often fatal.

The intestinal disease form of anthrax may follow the consumption of contaminated food and is characterized by an acute inflammation of the intestinal tract. Initial signs of nausea, loss of appetite, vomiting, and fever are followed by abdominal pain, vomiting of blood, and severe diarrhea.

Direct person-to-person spread of anthrax is extremely unlikely, if it occurs at all. Therefore, there is no need to immunize or treat contacts of persons ill with anthrax, such as household contacts, friends, or coworkers, unless they also were also exposed to the same source of infection.

In persons exposed to anthrax, infection can be prevented with antibiotic treatment.

Early antibiotic treatment of anthrax is essential–delay lessens chances for survival. Anthrax usually is susceptible to penicillin, doxycycline, and fluoroquinolones.

An anthrax vaccine also can prevent infection. Vaccination against anthrax is not recommended for the general public to prevent disease and is not available.

## Facts about Botulism

Botulism is a muscle-paralyzing disease caused by a toxin made by a bacterium called *Clostridium botulinum*.

There are three main kinds of botulism:

- Foodborne botulism occurs when a person ingests pre-formed toxin that leads to illness within a few hours to days. Foodborne botulism is a public health emergency because the contaminated food may still be available to other persons besides the patient.

- Infant botulism occurs in a small number of susceptible infants each year who harbor *C. botulinum* in their intestinal tract.

- Wound botulism occurs when wounds are infected with *C. botulinum* that secretes the toxin.

With foodborne botulism, symptoms begin within 6 hours to 2 weeks (most commonly between 12 and 36 hours) after eating toxin-containing food. Symptoms of botulism include double vision, blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, muscle weakness that always descends through the body: first shoulders are affected, then upper arms, lower arms, thighs, calves, etc. Paralysis of breathing muscles can cause a person to stop breathing and die, unless assistance with breathing (mechanical ventilation) is provided.

Botulism is not spread from one person to another. Foodborne botulism can occur in all age groups.

A supply of antitoxin against botulism is maintained by CDC. The antitoxin is effective in reducing the severity of symptoms if administered early in the course of the disease. Most patients eventually recover after weeks to months of supportive care.

## Facts about Pneumonic Plague

Plague is an infectious disease of animals and humans caused by the bacterium Y*ersinia pestis*. *Y. pestis*, is found in rodents and their fleas in many areas around the world.

Pneumonic plague occurs when *Y. pestis* infects the lungs. The first signs of illness in pneumonic plague are fever, headache, weakness, and cough productive of bloody or watery sputum. The pneumonia progresses over 2 to 4 days and may cause septic shock and, without early treatment, death.

Person-to-person transmission of pneumonic plague occurs through respiratory droplets, which can only infect those who have face-to-face contact with the ill patient.

Early treatment of pneumonic plague is essential. Several antibiotics are effective, including streptomycin, tetracycline, and chloramphenicol.

There is no vaccine against plague.

Prophylactic antibiotic treatment for 7 days will protect persons who have had face-to-face contact with infected patients.

## Facts about Smallpox

Smallpox infection was eliminated from the world in 1977.

Smallpox is caused by variola virus. The incubation period is about 12 days (range: 7 to 17 days) following exposure. Initial symptoms include high fever, fatigue, and head and back aches. A characteristic rash, most prominent on the face, arms, and legs, follows in 2-3 days. The rash starts with flat red lesions that evolve at the same rate. Lesions become pus-filled and begin to crust early in the second week. Scabs develop and then separate and fall off after about

3-4 weeks. The majority of patients with smallpox recover, but death occurs in up to 30% of cases.

Smallpox is spread from one person to another by infected saliva droplets that expose a susceptible person having face-to-face contact with the ill person. Persons with smallpox are most infectious during the first week of illness, because that is when the largest amount of virus is present in saliva. However, some risk of transmission lasts until all scabs have fallen off.

Routine vaccination against smallpox ended in 1972. The level of immunity, if any, among persons who were vaccinated before 1972 is uncertain; therefore, these persons are assumed to be susceptible.

Vaccination against smallpox is not recommended to prevent the disease in the general public and therefore is not available.

**In people exposed to smallpox, the vaccine can lessen the severity of or even prevent illness if given within 4 days after exposure.** Vaccine against smallpox contains another live virus called vaccinia. The vaccine does not contain smallpox virus.

The United States currently has an emergency supply of smallpox vaccine.

There is no proven treatment for smallpox but research to evaluate new antiviral agents is ongoing. Patients with smallpox can benefit from supportive therapy (intravenous fluids, medicine to control fever or pain, etc.) and antibiotics for any secondary bacterial infections that occur.

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# Bioterrorism Preparedness: What Practitioners Need to Know

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## Abstract and Introduction

### Abstract

A premeditated biologic attack against a civilian population is now a real threat. Several naturally occurring infectious agents and their products (for example, purified toxins) are among the candidates that have been and would be used in such a scenario. Familiarity with these agents and their associated diseases may help physicians recognize the possibility of a deliberate attack and manage the consequences.

### Introduction

Until recently, the specter of biologic warfare or bioterrorism was infrequently discussed by most physicians, despite the attention it had received from novelists, screenplay writers, politicians, and military defense strategists. Thankfully, most physicians have still never encountered the malevolent use of biologic agents, nor have they treated a victim of a biologic attack. In fact, despite their occasional occurrence in a "natural setting," as well as in recent events, clinical cases involving any of the classic biothreat agents are rarely encountered even by most infectious disease physicians.

For these and many other reasons, the intentional use of biologic agents has represented an exceedingly unlikely, hypothetical scenario for most clinicians. Yet, evidence mounts that the use of biologic agents as weapons is increasingly feasible and plausible in a civilian population setting. The events of September-October 2001 involving the deliberate delivery of anthrax spores through the US postal system provide an introduction to the issues and potential scenarios that can arise from the intentional use of biologic agents as weapons or as tools of fear. And nearly all predicted scenarios of intentional biothreat agent use place physicians at the leading edge of exposure and management.

Despite international bans such as the 1972 Biological and Toxin Weapons Convention, signed by more than 140 countries — including the United States— and heightened defensive planning on the part of the US military, the facts remain that lethal and highly noxious biologic agents are relatively inexpensive, are easy to obtain (with more than 400 strain repositories around the world, in addition to clinical microbiology laboratories), are easy to produce (most undergraduate, graduate, and postdoctoral students in microbiology and related fields have the necessary background), are easy to conceal, and are becoming increasingly easy to deliver.

Arguments have been made that biologic agents are the weaponry of the future; they represent the "poor man's atomic bomb." While the goal in state-sponsored warfare may be to kill substantial numbers of people, a terrorist organization or individual may employ biologic agents for less "ambitious" reasons: to incapacitate local populations, to cause social or political disruption, or simply to generate fear and mistrust. Though the concept is loathsome, the threat is nevertheless a real one.

The purposes of this article are to address the needs of infectious disease specialists and other health care practitioners as they are forced to confront this problem and to suggest that the topic of biologic war-fare and bioterrorism requires their involvement.

## Why the Concern?

Continuing political and military instability focuses sharp attention on the known capabilities and assets of nations such as North Korea, Syria, Iraq, and Iran. Iraq, for example, admitted to the development of nearly 400 missile warheads, bombs, and rockets armed with botulinum toxin, anthrax, and aflatoxin, which were released for use by forward-deployed commanders during the 1990-1991 Persian Gulf War. The fate and whereabouts of these weapons and even larger stockpiles of weaponized agents remain uncertain. Certainly, the combination of an unstable and despotic Iraqi leadership with ties to well-organized terrorist organizations, and recurrent Iraqi military humiliation by the United States increases the level of concern, as do recent political developments in the wake of the events of September 11, 2001.

Of even more concern is the recently publicized history of massive biologic weapons development in Russia beginning in the early 1970s and continuing into the 1990s. The agents purportedly stockpiled included *Bacillus anthracis;* variola virus (smallpox); various viral hemorrhagic fever agents; and a variety of nontraditional agents, including biologic response modifiers. The disintegration of the Russian state infrastructure may have led to the defection of key personnel to hostile nations and organizations.

With respect to non-state-sponsored biologic and chemical terrorism, Japan's Aum Shinrikyo cult reminds us of the potential capabilities of such organizations. The Aum cult produced botulinum toxin, *B anthracis* spores, and *Coxiella burnetii,* in addition to the nerve gas sarin and a wide array of other biologic and chemical weaponry. This cult visited Zaire during the 1992 Ebola fever outbreak, in an attempt to obtain Ebola virus samples for cultivation and weapon development. The cult's terrorist activities caused the deaths of 12 people from sarin gas exposure; anthrax was also used, but unsuccessfully. Closer to home, in 1984, the devotees of Bhagwan Shree Rajneesh infected 751 people in Oregon with *Salmonella typhimurium* by intentionally contaminating local self-service salad bars. In 1996, a disgruntled hospital microbiology laboratory technician in Dallas intentionally infected 12 coworkers with *Shigella dysenteriae*. The deliberate distribution of *B anthracis* spores through the US mail system in 2001 and associated cases of anthrax highlight the vulnerability of modern society and the difficulties in defining the origins and scope of the act (Box, page 502). In fact, the history of the intentional use of noxious biologic agents stretches back to antiquity. Table 1 highlights some events in the modern history of documented use of biologic weapons.

Small-scale terrorist attacks by their nature are more difficult to predict and detect. Such attacks may only be recognized well into the course of the epidemic, and perhaps long after the resolution of all clinical cases. Some of the potential agents (mentioned above) cause naturally occurring disease with some regularity. It is possible that other bioterrorist events in this country have gone unrecognized. Because these events are usually unannounced and because of the prolonged and variable incubation period of most biologic agents, it can be expected that emergency department staff and physicians will be among the first to encounter and treat the victims. Infectious disease consultants must heighten their awareness of irregular disease patterns and features and question the mechanisms of disease emergence.

## Biologic Weapons and Associated Disease

Some commonly acknowledged agents of biologic warfare, including intact microorganisms as well as purified toxins, are listed in Table 2. This list is by no means complete, nor does it

include nontraditional agents such as genetically engineered organisms, their products, or other biologically active molecules. Our focus here will be on naturally occurring agents that may cause unusual syndromes when employed intentionally and agents with which clinicians may be unfamiliar. Few randomized, blinded studies have been performed on which to base recommendations concerning within hours, and vary depending on dose and route of exposure. After inhalation of sublethal doses, symptoms include fever, tightness in the chest, cough, dyspnea, nausea, and arthralgias, beginning within 4 to 8 hours. More substantial aerosol exposures in animals lead to pulmonary necrosis and severe edema. Human exposures of this type are expected to cause progressive cough with severe pulmonary inflammation, cyanosis, and pulmonary edema. In animals, death occurs within 36 to 72 hours.

## Defending Against the Threat

On the subject of defense against biologic weapons, as with many complicated, rapidly evolving issues, there is good news and bad news.

The good news:

- Coordinated networks of epidemiologists, public health officials, clinicians, and laboratory investigators have begun to address infectious disease problems that are relevant both to the current health of the civilian population and to potential bioterrorism events. The Unexplained Deaths and Critical Illnesses Project of the CDC's Emerging Infections Program is an example. Other groups, such as the Working Group on Civilian Biodefense, based at Johns Hopkins University, have begun to discuss rational and realistic public health response plans for events of this type. The anthrax outbreaks of September-October 2001 have further motivated the strengthening of public health infrastructure.
- Microbial detection technology and strategies are advancing significantly. A wide range of novel and sensitive methods are under investigation in the public, academic, and private sectors.
- Treatment and prevention countermeasures have received renewed attention and funding in an effort to identify new targets and pathways for intervention. The Defense Advanced Research Projects Agency of the Department of Defense has made biologic warfare defense one of its top military priorities (www.darpa.mil/). Needless to say, efforts to develop defenses against biologic weapons also have immediate value in medicine and public health.

The bad news:

- Most of this relates to the sophistication and effectiveness of naturally occurring microorganisms as pathogens. Organisms that cause such infections as anthrax and smallpox have evolved shrewd strategies for rapid growth within humans, effective spread, and persistence in the environment. Determined efforts to package and disseminate these organisms will unavoidably present major challenges to our health and our health care system.
- Response by individuals and organizations at the local, regional, and national levels is not yet optimized.
- Engineered or modified biologic agents present even more formidable challenges and problems. Drug-resistant, vaccine immunity-evasive, and modified or chimeric organisms with altered virulence properties are all eminently feasible goals.

The achievement of some of these goals has been better documented than others. The same low-cost technology that has brought us revolutionary benefits in medicine is easily employed for negative purposes.

## Conclusions

The threat of a biologic attack against a civilian population is now recognized as a current and ongoing danger. It has been considered serious enough to warrant the creation of an unprecedented civilian medical stockpile of medicines and vaccines against likely biologic weapons. A 1997 economic analysis estimated an economic impact of $26.2 billion per 100,000 persons exposed to anthrax in some attack scenarios, with the possibility of billions of dollars saved through the widespread postattack use of antimicrobials and vaccine.

Regardless of the state of preparedness for such attacks, physicians and other health care providers have been and will continue to be the first to encounter victims of a biologic weapon. They will identify and define the scope of the "crime scene." It is therefore critical that they be familiar with biologic warfare agents, the syndromes that might be associated with their use, and features that might facilitate rapid recognition of intentional use and its differentiation from naturally occurring disease. Further education in this area can be acquired through electronic media at a variety of Web sites and through e-mail networks (Appendix), as well as at local and national conferences and workshops. Infectious disease specialists themselves serve as an important resource for other health care providers, public health officials, the news media, and the general population. Much of the harm that might result from bioterrorism in the form of unfounded fear and inappropriate actions can be ameliorated by effective educational efforts. Only adequate preparation can ensure that the impact of bioterrorism is minimized.

Further Information on Biologic Weapons: World Wide Web Sites

- The Johns Hopkins University Center for Civilian Biodefense Studies. www.hopkins-bioidefense.org. This site provides a comprehensive set of documents and links for useful information related to the commonly discussed biothreat agents.
- Association for Professionals in Infection Control and Epidemiology: bioterrorism resources: http://www.apic.org/html/resc/biomain.html. Provides links to useful publications and conferences.
- CDC bioterrorism homepage: http://www.bt.cdc.gov. Provides a searchable database for specific infectious diseases, and access to *MMWR* (*Morbidity and Mortality Weekly Report*).
- New York City Department of Health information resource concerning September-October 2001 anthrax bioterrorism: http://www.ci.nyc.ny.us/html/doh/html/alerts/911bio.html.
- "Emerging Infections Network" of The Infectious Diseases Society of America: http://www.idsociety.org/EIN/TOC.htm. Also bioterrorism resources for clinicians at the IDSA Web site. An electronic mail forum for dissemination of, and discussion about, unusual infectious disease cases and clusters of cases. The bioterrorism resource page provides links to teaching slide sets and other educational material.
- Medical NBC Online Information server: http://www.nbc-med.org/others/. Extensive news and information for military personnel and health care workers regarding nuclear, biologic, and chemical weapons.
- ProMED: http://www.promedmail.org/pls/promed/promed.home; or contact: majordomo@usa.healthnet.org. An electronic mail news service that provides a fascinating glimpse of clusters and outbreaks of infectious diseases around the world — followed in something close to "real-time." To subscribe, send e-mail message "subscribe promed" to the address above, or follow directions at the Web site.

† Continue prophylaxis for 60 days if vaccine is not availbale.

From US Army Mediacal Research Institute for Infectious Disease. Medical Management of Biological Casualties Handbook. 1998; Franz DR et al. JAMA. 1997.

## Recommended Readings

The authors suggest the following sources for readers seeking further information:


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- Kaplan DE, Marshall A. *The Cult at the End of the World.* New York: Crown Publishers; 1996. A fascinating look into the tactics and history of the Aum Shinrikyo cult, including details of their weapons programs.
- Preston R. *The Cobra Event.* New York: Random House; 1997. An engaging and terrifying look at the present and possible future by a popular novelist.
- United States Army Medical Research Institute for Infectious Diseases. *Medical Management of Biological Casualties.* 3rd ed. Fort Detrick, Frederick, Md: USAMRIID; 1998. An invaluable resource that gives history, clinical information, and treatment/vaccine options for many potential agents of biologic warfare. Also traces the history of biologic warfare events and current prevention strategies. Can be downloaded free of charge from the Web (http://www.usamriid.army.mil/education/instruct.html).



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# PRESIDENTS' STATEMENT

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EDITOR'S NOTE: Find links to current science-based information about anthrax, bioterrorism and other security topics in the text below.

Statement from
Bruce Alberts, President, National Academy of Sciences,
Wm. A. Wulf, President, National Academy of Engineering,
and Kenneth I. Shine, President, Institute of Medicine

Oct. 29, 2001

News reports are emerging — seemingly on an hourly basis — about new developments that may be linked to bioterrorism. No matter what the source of these attacks, we believe Americans can best protect themselves by being armed with the best available information from scientifically credible sources.

Our nation already has a wealth of information and many experts to help answer questions about every conceivable threat. Americans can ill afford to rely on hearsay or information coming from those outside the scientific and medical communities who may mean well but lack solid data supported by evidence. We call on journalists, our political leaders, and all citizens to seek the best available information from the most reliable sources as we learn more about the magnitude of the current bioterrorism threat.

As we ourselves monitor daily developments, we continue to be alarmed by the amount of inaccurate information being circulated about anthrax, sending scores of confused citizens to take action that may, in fact, be counterproductive. A multitude of Web sites and self-appointed experts have emerged in the past weeks, hawking everything from gas masks to colloidal silver. The fact is many of these remedies may well do more harm than good or have serious side effects.

We urge everyone to take advantage of the useful bulletins being provided by a number of trustworthy sources. The Web sites of the **Centers for Disease Control and Prevention**, **National Library of Medicine**, and the **Johns Hopkins Center for Civilian Biodefense Studies**, for example, carry information of excellent quality. Finally, the National Academies have been studying issues of counterterrorism for many years. While mainly for policy-makers, **a collection of these reports is available free on our Web site** for interested readers.

Our nation has tremendous scientific and technical resources that can be marshaled to help us deal with terrorist actions. The National Academies stand ready to contribute in every way possible.

Never before has the adage "Information is power" rung so true. Armed with the facts, Americans can make enormous progress in combating terrorism.

###

# SYNOPSES OF STUDENTS' LECTURES

The following six students were selected for presenting their lectures on the respective topics, at the Student Lecture Competition, at the workshop:

M.SC., STUDENTS

## 1. RECENT TRENDS IN AIDS RESEARCH

C B Appaiah, II M. Sc., Microbiology
National First Grade College

The discovery of HIV, the virus that causes AIDS, led to a concentrated research effort in the late eighties and early nineties to understand the virus and its interaction with the host. Several breakthroughs were achieved over the past six years due to technological advances. However, several questions remain unanswered. The first major breakthrough came with the development of protease inhibitors and administration of cocktail drugs called HAART (Highly Active Anti-Retroviral Therapy). The administration of HAART cleared the virus to undetectable levels in several patients. However, it also led to the generation of multi-drug resistant viruses. The discovery of co-receptors utilized by the HIV provided an additional site for drug targeting. Studies on the kinetics of the HIV replication suggested that a high replication rate of HIV even during the asymptomatic phase. Several Caucasian HIV infected individuals remained healthy without progressing to the AIDS stage due to mutation in the receptor gene. This provided one of the first evidences of natural resistance to HIV. The etiologic agent of Kaposi's Sarcoma was found to be human herpes virus-8. The elucidation of the structure of the HIV enzyme integrase and the transcriptional activator protein Tat, make them targets for drugs. Several promising approaches are underway to develop an effective AIDS vaccine. An oral Salmonella-DNA vaccine that carries gp 120 gene from HIV has been found to induce strong mucosal immunity, a phenomenon rarely seen with traditional vaccines. Resveratrol, a chemical found in red grapes, peanuts and several tree species was found to be a potent inhibitor of HIV when combined with nucleoside analogues. Concentration of anti-viral drugs needed to inhibit HIV was reduced by 90 per cent in the presence of resveratrol. The creation of a Tat toxoid has been found to generate a strong humoural and cell mediate immune response. The rapidly evolving field of genomics could lead to a better understanding of the human genome and help identify genetic factors that determine immune response. The progress made so far in the understanding the key aspects of HIV infection has strengthened the resolve of researchers to conquer the disease. This renewed commitment and advances in AIDS research in the years to come will make it possible to meet this unprecedented challenge.

## 2. CLONOING: CRITICS AND ETHICS

Divya Saxena, I M.Sc., Biotechnology
National First Grade College

Biotechnology promises the greatest revolution in human history to an extent that it has even outdistanced atomic power and computers in their effects on our everyday lives. Biotechnology benefits continue to be heavily advertised. Its risks are too little discussed. Although the techniques are too powerful and negative impacts are but natural side effects, we cannot afford to be ignorant about the ethical, social, legal, environmental and health a impacts of this technology. Biotechnology may cause questions of discrimination and exploitation of women. Crossing the species boundaries in genetic exchanges resulting in to the inserting animal genes into human or human genes into animals and inserting plant genes into microorganisms and other species, is unacceptable. Patenting genetically engineered animal is equating it to status of manufactured products. The biotechnological innovation in diagnostic procedures will undermine individual privacy. The genetically engineered foods will be unable to ensure

compliance to the persons, who follows the religious, dietary restriction and beliefs. Vegetarians may be forced inadvertently to take food containing genetic material from insect, fish, pigs or other animal. Human lactoferrin and human lysozyme are expressed in cow's milk and it will be used by mothers for their infants. Gene therapy should be restricted to be alleviation of genetic diseases in individual patients and should not be sued to change or enhance normal human traits. Attempts to patent human DNA sequences which is our common heritage is a disgusting side of research on human genome. The creation of Dolly, is more certain revolutionary achievement in reversing the biological clock, i.e., by converting the specialized mammary gland cells into cells with reproductive capacity. The cloning experiments have created an anxiety, fear in every body's mind because although benefits are possible out of use of this technique the potential for misuse use is real. As if man becomes a creator of human being, the world will be of limited meaning and it might lead to the deterioration of humanity. The very power of biotechnology outstrips our capacity to use it in safety, that neither resilience nor our own social institutions are given adequate protection against the unanticipated impacts of genetic engineering. Just because cloning can be done it doesn't mean it should be exploited. And, the scientists should not be blamed for making these kinds of discoveries. It is now up to the society to decide how it should be used.

BSC., STUDENTS

## 3. GOLDEN RICE

Gaurav G. Kashyap, III B.Sc., Biotechnology

SSMRV College

**What is Golden Rice?**

Golden Rice is a transgenic variety of rice with genes for the synthesis of β-carotene taken from the temperate garden favourite *Narcissus pseudonarcissus*, which is commonly called daffodils, is introduced into the genome of common temperate strain of rice using *Agrobacterium tumefaciens* . This grain is golden or pale yellow instead of a normal pearly white when compared to that of a normal commercial strain. This is due to the presence of β-carotene.

Ingo Potrykus saw a hope for millions of poor children in introducing the gene of β-carotene in the rice itself which is the staple food. Peter Beyer, an expert in the biosynthetic pathway of β-carotene in daffodils became an associate. The choice of daffodils as a sources of β-carotene was obvious since it contains an exceptionally high concentration of β-carotene.

β-carotene is extremely important to us as it is the most efficient precursor of retinal, hence is a pro-vitamin A. The liver converts one molecule of β-carotene into two molecules of vitamin A, which is the only way we can get our requirement of vitamin A.

Deficiency of vitamin A causes dry skin, dry eyes, dry mucous surfaces, retarded development and growth, sterility in males, night blindness and other types of irreversible blindness.

**Criticism faced by Golden Rice**

1. Greenpeace society, which is a forefront organisation for criticizing biotechnology products, calls Golden Rice as "fool's gold".
2. Many say Golden Rice cannot give all the necessary nutrients.
3. Greenpeace suggests that supplementation of β-carotene through pills, which is impracticable.
4. Some organizations say Golden Rice contains genes!
5. Some claim that Golden Rice may become a dangerous weed.
6. Some organizations say scientists are meddling too much with the laws of nature.

However, Golden Rice holds a promise to benefit the poor, by providing at least some quantity of the precursor of vitamin A.

## 4. DNA AS A SEMICONDUCTOR

Tuhin Bhowmick, II B.Sc., Biotechnology
PES College

A new window towards future right now... today the worldwide researches & developments are going on in two main fields...

1. Computer science & electronics.
2. Biotechnology & genetics.

But, this new era starts with the true fusion of both making of nano-machines out of bio-molecules, and the use of DNA as a SEMICONDUCTOR.

### WHY DNA?

1. It is one of the best-understood biomolecules ever yet, and
2. It has a unique capacity for self assembly.

### HOW IT CONDUCTS?

1. Due to the difference between the oxidation & reduction potential of the bases, and
2. The distance between two parallel base pairs present in a DNA double helix filament.

### DIFFICULTIES:

The energy gap present between the conduction hand & the valence hand is high...so not very efficient in electron conduction if compared with the inorganic competitors (Si, Ge).

### M-DNA IS THE ANSWER:

M-DNA is natural DNA modified to metallic DNA by the group of scientists...lead by Dr. Jimmy Xu.

DNA placed in high pH ~ 9.0 solution containing metal ions like zinc, cobalt etc....the metal ion replaces imino-proton from DNA & it gets coaxed in the filament. This indicates the metallic DNA (M-DNA)...which is having a

1. Much less energy gap between two hands.
2. The conductance hand is much wider...& that makes M-DNA an ideal nano scale semiconductor for building high-density circuits.

**LOGIC GATES OUT OF DNA:**

The short fragments of a DNA filament... each having particular sticky ends complementary for a specific one-only kept in solution... & each tile is responsible for carrying signals like O or I (specified by its affinity to a specific restriction enzyme)...DNA fragments arrange themselves in a particular & specific manner...following the positions of tiles according to signals O or I we can find logic gates like formation of XOR -gate.

DNA nanotubes: - nano tube transistor - rosette shaped nanotubes can be made out of two base pairs present in DNA like guanine & cytosine...due to their hydrophilic & hydrophobic interaction when placed in water or some other solution...

We can place metal ions inside the hollow of these nanotubes &use them for conductance of light & electricity also...& moreover these conductance properties are very similar to FET (Field Effect Transistor).

DNA can also be doped in suitable ions & acting as n-type or p-type semiconductor & used to make diodes or 3-junction devices (base collector emitter).

DNA devices detect light signals- microthin deoxy- guanisine layer spread upon gold electrode can be used as a photo diode in a photodetector device.

So, from DNA to semiconductor→ diode→transistor→integrated circuit (IC)→& we all know where the roads leads to ...bimolecular nano machines→ computers made of biomolecules.

Though it is very new concept & lots of barriers still existing...but we should think of the possibilities & take it as a challenge ... & go on exploring to the way of success.

## 5. TRANSGENIC PLANTS

P Vidya, II B.Sc., Microbiology
Maharani Lakshmi Ammanni College

Genetically Modified (GM) foods have made a big splash in news lately.

**What are GM Foods?**

The term GM foods or GMOs (Genetically Modified Organisms) is most commonly used to refer to crop plants created for human or animal consumption using the latest molecular biology techniques. These plants have been modified in the laboratory to enhance desired traits such as increased resistance to herbicides or improved nutritional content. The enhancement of the desired traits has traditionally been undertaken through breeding, but conventional plant breeding is very time consuming. Genetic Engineering, on the other hand, can create plants with the exact desired trait very rapidly and with great accuracy to produce crop varieties known as Transgenic plants. The best example is the use of genes that produce toxic crystal proteins of *Bacillus thuringinesis,* to develop insect resistant crops such as soybean, corn, cotton, canola and potato.

**Examples of GMFs**

Recombinant DNA technology has not only enhanced the health of humans but has also contributed to exciting developments in agricultural biotechnology. We now have transgenic plants and food crops with desirable properties such as flavour, nutrition, as well as insect resistance.

Some of the GMFs which are being marketed or currently under research are:

FLAVR SAVR tomatoes, New Leaf potatoes, Golden Rice, Bt Sunflower, EDIVACS—edible vaccines, Nicotine-free tobacco, Sun-papaya and Biotech bread.

**Techniques used for production of transgenic plants**

Plant improvement has been a continuous effort by man ever since he settled down and started to raise crops for food and medicines. It began first by collecting seeds from good cultivars and collecting good clones of fruit and ornamental plants. The an era of modifying genetic make up of the plant by controlled crossing took birth, and today GE has given us the tools to modify the genetic make up of the plant at will. Genes can be transferred from unrelated organisms. The following are the means of achieving the objectives:

1. Natural delivery system: DNA transfer via pollen; pollen tube pathway; implant transformation.
2. Artificial delivery system/direct DNA transfer techniques: Physical methods are electroporation, laser microbeams mediated gene transfer, ultrasound mediated gene transfer and silicon carbide fibre mediated gene transfer, while chemical methods are PEG mediated transfer, calcium phosphate co-precipitation method, DEAE dextran procedure and DNA-Diffusion/inhibition by cells, tissues, embryos and seeds.
3. Biological vector system: Agrobacterium mediated transformation and virus mediated transformation, with two variants, the caulimo viruses and Gemini virus mediation.
4. Non-biological vector system/forced membrane penetration: Microprojectile mediated transformation (air gun device, particle inflow gun device, ballistic PDS-1000 He device, Gene Booster technology and ACCEL technology), Microinjection fusion/ liposome mediated gene transfer and Microinjection mediated gene transfer.

**Advantages of GMOs**

The world population has topped six billion people and is predicted to double in the next 50 years. Ensuring an adequate food supply for this blooming population is going to be a major challenge in the years to come. GM foods promise to meet this need in a number of ways.

**Disadvantages**

Environmental activists, religious organizations, public interest groups, professional associations and other scientists and governmental officials have all raised concerns about GM foods and criticized agribusiness for pursuing for profit without potential hazard evaluation.

Disadvantages of GM foods fall under three categories: environmental hazards, human health risks and economic concerns.

**Legal aspects and concerns**

There are many problems like patenting of GMFs that have to be taken care of. All GMFs are to be labeled before they enter the market.

## 6. STEM CELL RESEARCH

Vidhya Ramachandran, B.Sc.
SBM Jain College

Man has always fantasised about being able to *' grow'* organs and cells in a laboratory, replenish the human body as the need arises and thus virtually be *'immortal'*. This fantasy could soon be reality, thanks to the fast growing area of *'Stem Cell'* research.

### WHAT ARE STEM CELLS?

Stem cells are undifferentiated cells having the ability to form any adult cell and proliferate indefinitely in culture.

The fertilized egg is *totipotent* and after about four days of fertilization and numerous cycles of cell division, a hollow sphere of cells *blastocyst* is formed. Blastocyst has an outer layer of cells and inner cluster of cells *Inner cell mass.* This inner cell mass goes onto form virtually all of the tissues of the human body, but not embryos. Hence, they are not totipotent but pleuripotent.

### WHAT IS SO SPECIAL ABOUT STEM CELLS?

The great importance of stem cells lies in their ability to develop into virtually any other cell of the human body.

- If stem cells are cultured and their development directed in culture it would be possible to grow cells of medical importance like bone marrow, neural tissue or muscle tissue. This is called *cell therapy* for disorders regulating from disruption in cellular function or destruction of tissues, e.g. Parkinson's and Alzheimer's, spinal chord injury, stroke burns, heart disease, diabetes, arthritis.

- Applications in the areas of *drug discovery* are immense as drugs can be tested on specific cell types and the response can be measured. This means rapid testing of chemicals, which are now being tested by time-consuming methods.

- *Study of human development* will also be benefit from embryonic stem cell research, allowing prevention or treatment of abnormal human development.

### HOW DOES ONE 'GROW' THESE STEM CELLS?

The sources for stem cells could be the following

- *the inner cell mass* of blastocyst can be cultured to produce pleuripotent stem cell line

- *Foetal tissue* obtained from terminated pregnancies.

- *Use of somatic cell nuclear transfer*-a normal animal egg is enucleated and fused with a somatic cell. The resulting fused cell & its progeny are totipotent & could further form a blastocyst.

The stem cells, thus derived are placed in a culture where they proliferate. Scientists can then direct the undifferentiated stem cells to become specific cell types or tissues.

### WHY NOT SIMPLY USE ADULT STEM CELLS?

Recent research proves that adult stem cells (e.g. haematopoietic stem cells), previously thought to be committed to development of one line of specialized cells can develop into other specialized cells, as for example, stem cells of bone marrow could produce liver cells.

*Potential* of adult stem cell culture is immense as the patients own cells are used, thus the problems of immune rejection and ethical issues do not arise.

## LIMITATIONS

- Adult stem cells *cannot be isolated* for all tissues; example, adult cardiac stem cells & adult pancreatic islets stem cells have not been located.
- Present in *minute quantities* and hence difficult to isolate and purify, and also, their number decreases with age.
- *Not readily available* for immediate medical use as they require time for culturing.
- In case of genetic disorders, the adult stem cells would also contain the *genetic defects.*
- Adult stem cells may have more *genetic abnormalities*.
- Adult stem cells *are not pleuripotent* as they give rise to 3-4 cell types.

## SO, WHAT IS ALL THE HYPE ABOUT?

Research has revealed the enormous future potential of stem cells, like stem cells that developed into *neurons* could help repair spinal chord or brain injuries due to Parkinson's disease.

Undifferentiated human embryonic stem cells could be guided down the developmental pathway to form *blood cells* to be used in transfusion or transplantation.

Transplantation of embryonic stem cells could help *repair heart muscles* and improve cardiac function following heart attacks and congestive heart failures.

Combination of chemotherapy and stem cell transplant could be used against multiple myeloma (bone marrow cancer).

*Pancreatic islet cell lines* derived from human pleuripotent stem cells could be used in type I diabetes research and ultimately used for transplantation.

## IS IT REALLY AS SIMPLE AS IT SOUNDS?

Practical application of stem cell research is not a "cake walk". Numerous *technological challenges* remain to realise the potential of stem cell research.

Need for basic research to understand cellular events leading to *cell specialisation* so that pleuripotent stem cells can be directed to form the desired type of tissue.

Before cells can be used for transplantation, the problem of *immune rejection* must be overcome, as the embryonic stem cells would be genetically different from the recipient (this problem is avoided in adult stem cell culture and somatic cell nuclear transfer).

Other than these technological challenges, there have always been *ethical issues* surrounding stem cell research.

## FUTURE POTENTIAL

The future of stem cell research is in our hands and it is up to us, whether or not it is utilised to its full potential for the betterment of mankind. To pursue stem cell research would be to give hope to millions, beyond the capability of conventional medicine.

# BIOTERROR AND BIOSAFETY

- The Hindu, Thursday, November 01, 2001

Sir, - In the opinion column 'Bioterror and biosafety' (Oct. 19), Ms. Vandana Shiva exploits th recent anthrax cases to advance her anti-science agenda. By painting a gloomy scenario again economic freedom, she calls for an isolationist and backward policy for India.

The use of these biological agents by malicious individuals to inflict harm and fear on an innocer public is evil. But for Ms. Shiva to use this unimaginable evil and horror to rail against imaginary ills of recombinant DNA technology, trade liberalisation and patenting system i intellectual chicanery. Her argument is akin to saying that because terrorists used planes and th mail system to cause destruction, we must ban aircraft and the postal system - that is throwing th baby out with the bath water!

Bioterrorists do not need sophisticated recombinant DNA technology to spread germ or fear. Simpl microbiology would suffice.

Civilised societies can protect themselves against terror by continued development and disseminatio of scientific knowledge. Effective antibiotics to treat anthrax were developed after many years of research and testing. This required a systematic use of scientific knowledge, a paten protection system to stimulate innovation, and a free-market system that rewards such risk- takin - all of which Ms. Shiva despises. The real bioterror plaguing India has to do with poverty. Million of people die every year by natural, but preventable, causes through diseases such as cholera malaria, AIDS and TB. These diseases can only be fought through economic progress an development of modern medical systems.

*C.S. Prakash*
*Tuskegee, U.S*

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*C.S. Prakash*
*Tuskegee, U.S*

## NATURALLY OCCURRING MUTAGENS AND CARCINOGENS IN COMMON FOODS AND BEVERAGES

The following common foods and beverages contain the naturally occurring chemical compounds that were shown to be mutagenic/carcinogenic in rodents. Some (marked by asterisk) were also found to have similar effects on humans.

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Apples: Acetaldehyde, benzaldehyde, caffeic acid, quercetin glycosides

Basil: Estragole, methyl eugenol

Black pepper: D-limonene, safrole

Bread: Acetaldehyde, benzopyrene, ethyl alcohol*, ethyl carbamate, furan and its derivatives, furfural

Broccoli: allyl asothiocyanate

Butter: Benzene

Carrots: Aniline, caffeic acid

Celery: Caffeic acid, furan and its derivatives, psoralens

Cherry tomatoes: Caffeic acid

Cinnamon: Coumarin, methyl eugenol

Coffee: Acetaldehyde, benzaldehyde, benzene, benzopyrene, benzofuran, caffeic acid, catechol, 1;,2,5,6-dibenzanthracene, ethyl benzene, furan and its derivatives, furfural, hydrogen peroxide, hydroquinone, 4-methyl catechol

Grapes: Caffeic acid

Groundnuts and other nuts: Aflatoxin*, furfural,

Jamine tea: Benzyl acetate

Lettuce: Caffeic acid

Liquors: Ethyl alcohol*

Mangoes: Caffeic acid, D-limonene

Mushrooms: Furan and its derivatives, hydrazines,

Mustard: Allyl asothiocyanate

Nutmeg: Methyl eugenol, saffrole

Onions: Furan and its derivatives, quercetin glycosides

Parsley: Psoralens

Pears: Caffeic acid

Pineapple: Ethyl acrylate

Potatoes: Caffeic acid

Pumpkin (pie): Benzopyrene

Red wine: Ethyl alcohol*, ethyl carbamate

Roasted beef: Benzene, heterocyclic amines

Sweet potatoes: Furan and its derivatives, furfural

Tea: Benzopyrene, quercetin glycosides

Tomatoes: Acetaldehyde, benzaldehyde, hydrogen peroxide, quercetin glycosides

Turkey: Heterocyclic amines

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Source: American Council on Science and Health, New York, at URL: http//:www.acsh.org.

# NATURE ARTICLE ON MEXICAN GENE FLOW BASED ON WRONG MOLECULAR DATA

Several labs specialised on tranformation of crops around the world have analysed the data published in Nature (Transgenic DNA introgressed into traditional maize landraces in Oaxaca, Mexico by David Quist & Ignacio H. Chapela Department of Environmental Science, Policy and Management, University of California, Berkeley, California 94720-3110, USA; Nature, vol. 414, 29 November 2001) and came to the conclulsion that the molecular lab work is deeply flawed.

1. There might one day pop up some transgenes in landraces - it should not be considered 'contamination' but we should evaluate the situation and most probably we would come the the conclusion that these are improvements welcomed by the Mexican farmers, - unless they have surrendered to the fearmongering of activist groups - which - according to eye witnesses, seems unfortunatly to be the case already. These activists have already done a perfect job.

2. Previous data show, that gene flow has always happened and landraces have survived nevertheless with their identity quite nicely. Landraces in Mexico are subject to century old improvement selection strategies of the farmers and are certainly nothing natural. There are also data showing that the even the wild maize species, the Teosinthes, may be subject to gene flow for already a long time,

3. Cross Compatibility within the genus Zea Laboratory of Genetics University of Wisconsin
http://www.cimmyt.org/ABC/geneflow/geneflow_pdf_engl/Geneflow_Cross.pdf
<http://www.cimmyt.org/ABC/geneflow/geneflow_pdf_engl/Geneflow_Cross.pdf>

4. 'Experienced investigators often spot maize-teosinte hybrids in maize fields infested with teosinte. Most reports suggest that they are infrequent. Most often they are rare relative to expectations, based on random crossing between maize and teosinte. For example, if random mating with no selection or migration occurred in a population comprising 90% maize and 10% teosinte plants, the ratio of hybrids to teosinte plants in the next generation should be 18:1. But hybrids have always been a minority class. Many factors, including human agency, contribute to the isolation of maize and teosinte. The presence of barriers to dent maize within mexicana teosintes, which typically grow in close association with maize, together with the absence of barriers in parviglumis teosintes, which typically grow in dense strands outside of
maize fields, sets up the presumption of a role for these barriers in isolation.'

and:

5. T. Angel Kato Y. 1999
Review of Introgression Between Maize and Teosinte Genetics Program, Genetic Resources and Productivity Institute (IREGEP), Colegio de Postgraduados, Montecillo, Mexico
http://www.cimmyt.org/ABC/geneflow/geneflow_pdf_engl/Geneflow_ReviewIntro.pdf
<http://www.cimmyt.org/ABC/geneflow/geneflow_pdf_engl/Geneflow_ReviewIntro.pdf>

these are two of the articles of the Proceedings of a Forum:
Gene Flow Among Maize Landraces, Improved Maize Varieties, and Teosinte:
Implications for Transgenic Maize

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http://www.cimmyt.org/ABC/Geneflow/geneflow_pdf_Engl/contents.htm
<http://www.cimmyt.org/ABC/Geneflow/geneflow_pdf_Engl/contents.htm>

see CIMMYT-Publications catalogue http://www.cimmyt.org/Resources/Publications/catalog2001/PubCat2001-ABC.htm <http://www.cimmyt.org/Resources/Publications/catalog2001/PubCat2001-ABC.htm 1153. Manual. 1999. 141 pp. Paperback. ISBN: 970-648-041-2. ($7.00, $3.00)
Gene Flow Among Maize landraces, Improved Maize Varieties, and Teosinte: Implications for Transgenic Maize (PDF format)

Serratos, J.A., M.C. Willcox, and F. Castillo-González (eds.) Proceedings of a forum jointly organized by the Mexican research and biosafety agencies and CIMMYT in 1995, this publication compiles presentations and discussions on the distribution of teosinte in Mexico, the frequency and intensity of gene flow between maize and teosinte, the flow of genes from improved maize to landraces, and regulation and risk assessment for the testing and release of transgenic maize in the center of origin for this crop and for teosinte.

The authors also hint to the difficulties demonstrating gene flow properly, they also cite a statement by Smith and Goodman (1981) which says: "Attempts to estimate levels of gene flow and the extent of genetic erosion will have limitations, regardless of the character used, since it is impossible to demarcate clearly the contributions of ancestry, selection and gene flow."
Therefore, future data with clear transgene and other markers will reveal with more clarity what is going on since centuries, thats just about all.
And if you haven't had enough reading, go to the rich literature list of maize diversity at:

http://www.stat.ncsu.edu/~panzea/literature.html
<http://www.stat.ncsu.edu/~panzea/literature.html>

6. C.S. Prakash, December 19, 2001

## SCIENTISTS SAY MEXICAN BIODIVERSITY IS SAFE

### Concerns About Cross-Pollination Unfounded

Auburn, AL, December 19, 2001: Following allegations that genes from biotechnology-improved crops have been found in varieties of corn grown in Mexico, scientists around the world are reaffirming that Mexico's biological heritage is safe and that biotechnology will actually protect andenhance biodiversity, not harm it. "Organizations with a vested interest have used these tenuous claims and mounted a campaign of hysteria to discredit modern biotechnology," said C.S. Prakash, a professor of plant genetics at Tuskegee University and president of the AgBioWorld Foundation.

Activist groups claim they are concerned that gene flow will destroy biodiversity in native varieties of corn. However, corn itself is a wholly un-natural plant created by thousands of years of selective breeding by farmers. In Mexico, farmers reproduce their varieties by carefully selectingthe seed they save from year to year. Thus, if an undesirable gene is transferred into certain plants, seed from those plants will not be planted the following year and will be eliminated from the gene pool. This cultural practice explains why Mexican farmers can plant many different varieties next to one another, without worrying about cross-pollination.

"There is no scientific basis for believing that out-crossing from biotech crops could endanger maize biodiversity," said Dr. Luis Herrera-Estrella, a noted plant scientist and director of the Center for Research and Advanced Studies (CINVESTAV) in Irapuato, Mexico. "Gene flow between commercial and native varieties is a natural process that has been occurring for many decades. Nor is there reason to believe that these genes will become fixed into landraces unless farmers select them for their increased productivity,"

7. Herrera-Estrella. "In the end, that would result in improving the native varieties."

The claims of cross-pollination have not been verified and have been called into question by scientific experts. That has not stopped the Mexican Congress, or Greenpeace and other anti-technology activist groups, who have called for a ban on the import of biotech corn varieties. Such a move would do nothing to protect biodiversity. It would, however, damage agricultural production and trade ultimately harming Mexican farmers. "The biggest threat to Mexico is not out-crossing from biotech crops, but activism that prevents farmers from adopting more productive agronomic practices," said Dr. Prakash. "That's the only real damage this whole scenario will cause."

Thousands of scientists from around the world including Nobel laureate Dr. Norman Borlaug, who has worked in Mexico for the past five decades have endorsed biotechnology as a safe and productive means for helping to improve food security, while reducing pesticide use and improving biodiversity. In the mean time, the Mexican government has established a program to verify the allegations and to determine whether such out-crossing could cause any possible harm. "The most responsible step right now would be to postpone potentially harmful legislation and other action until this full and independent analysis is conducted," concluded Dr. Prakash.

# SOME TERMS YOU SHOULD KNOW

A number of new terms have been creeping into or deliberately introduced into, the current communications on biotechnology. With the use of acronyms for most of them, understanding information is becoming increasingly difficult. Being familiar with these terms will make things clearer. Since the entire terminology cannot be given at one go, the FBAE will randomly provide explanations to them, at different opportunities we get to do so.

Biodefence: the tools and preparedness to face bioterrorism.

Bioterrorism: the clandestine spread of pathogenic organisms or biological toxins to cause large scale death or to incapacitate large sections of vulnerable populations and/or livestock or to destabilise the environment, to force a country into submission, in favour of a particular political or religious philosophy.

Bt: *Bacillus thuringiensis*, the naturally occurring soil bacterium, that causes disease in insects. The disease causing genes have been inserted into the genomes of various crops to make them pest resistant.

Bt cotton: a transgenic variety of cotton that contains the insecticidal genes from *Bacillus thuringiensis* (similarly Bt potato, Bt tomato, Bt tobacco, etc.).

BT: Biotechnology (biological technology): large (industrial) scale use of organisms or their products to provide products and/or services.

BSE: Bovine Spongiform Encephalopathy, commonly referred to as the Mad Cow Disease, a prion disease that affects cattle. Humans who consumed food contaminated with BSE develop the New Variant Creutzfeldt-Jakob's Disease (nvCJD).

CBI: Council for Biotechnology Information, an Industry Association based in the US, founded in 2000, which represents almost all major biotech corporations and supplements their US public relations campaigns.

Eurobarometer: Public opinion survey conducted to gauge public sentiment in Western European countries towards science and technology.

EU: European Union, a union of 15 Western European countries, which acts to co-ordinate member governments in trade, economic and other types of policy. Now, EU has a common currency, the Euro, the sole currency in most of the EU countries, with a few exceptions.

Franken food: the derogatory nickname for genetically modified foods.

Fungibility: the process of weighing advantages and disadvantages of an action.

GE: Genetic Engineering, the application of engineering processes and ideas to biological mechanisms and subjects.

GM: Genetic Modification, the insertion of genes from other organisms (within or between species) into host cells to select for desirable qualities.

GMO: Genetically Modified Organism, an organism to which genetic modification has been applied.

Genschutz Initiative (GPI): the 1998 Swiss Referendum campaign whose goals were the prohibition of all transgenic animals, the banning of all field releases of transgenic crops and the prevention of patenting certain inventions in biotechnology. This referendum was voted down by a 2-1 margin.

Golden Rice: a genetically modified variety of rice that contains genes that code for β-carotene; a precursor for the synthesis of vitamin A in our body.

Mutual Gain Approach: a method of public relations that emphasises the acknowledgement of the concerns of the other side, and actions that are based on trust and the wish to establish long term relationships.

NGO: Non-Governmental Organisation; there is a vast number of NGOs in different parts of the world, working for a very wide variety of causes.

nvCJD: see BSE

Novel Foods: food products derived from GMOs.

Pastoralism: the theory which states that a social complexity or change will almost always result in a negative response.

Press agentry: a method of public relations whose main objective is accruing positive publicity for a cause or organisation through mass media.

Public information: a public relations method that looks to accrue positive publicity through mass media by using the release of selective information about the issue or organisation.

RAFI: Rural Advancement Foundation International, a non-governmental organisation with headquarters in Canada, working in the interests of farmers.

Rivalling rationalities: the instance in which there are different viewpoints on an issue, but even when the viewpoints are different, they are not different in a way that necessarily makes one wrong whenever the other is right.

Superweeds: the possible result of the cross-pollination between genetically modified crop and its natural counterpart found in the environment. It is theorised that this cross-pollination may create weeds that are herbicide and insecticide resistant.

Terminator Genes: a derogatory name given by RIFA, to the technology of genetic engineering aimed at controlling plant gene expression, particularly the one that prevents the germination of seed of a crop during the second generation, due to the activation of genes that code for ribosome inhibiting proteins (RIP). The activation of the specific genes for the RIP requires an external stimulus, to function as a gene switch, such as tetracycline. There is no situation in normal agriculture to spray this expensive antibiotic. This technology has been thwarted in the face of opposition from NGOs and has not been incorporated into any crop that has been released. Originally intended to control gene expression at a particular stage of plant development, a particular tissue, particular environmental conditions, or a particular time or location or a combination of these situations, the technology could have been utilised for several beneficial purposes

Traitor technology: the technology that was designed to silence the traitor genes in a plant.

Transgenic Organisms: genetically modified organisms, such as Bt cotton or Golden Rice, that contain selected genes from one (donor) incorporated into the genome of another (recipient).

Two-way asymmetric: a public relations method in which a company markets their ideas to a specific demographic.

Two-way symmetric: a public relations method that is used when conflict has arisen, and calls for negotiations and compromise between an organisation and its opposition. This strategy forces the organisation to not only research the public, but also to communicate with it.

***Compiled by C. Kameswara Rao***

# CROP BIOTECH

January 4, 2002

*A weekly summary of world developments in agri-biotech for developing countries, produced by the Global Knowledge Center on Crop Biotechnology, International Service for the Acquisition of Agri-biotech Applications SEAsiaCenter (ISAAA), and CAB International*
January 4, 2002

In This Issue:
* **CIMMYT Doubts Transfer of GM Corn DNA to Local Varieties**
* **Asia Invests in Biotechnology**
* **Reports on Bt Cotton Trials Favorable**
* **Knowledge Center BICs to Meet in Bangkok**
* **Announcements**

## CIMMYT DOUBTS TRANSFER OF GM CORN DNA TO LOCAL VARIETIES

Research being conducted at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico has cast some doubt over earlier reports that DNA from genetically modified corn has been transferred to local varieties in Mexico. The CIMMYT study could not detect the 35S promoter either in historical accessions from its own seed bank or in samples collected recently from the field in Mexico. Results of the study were published in the January 2002 issue of Nature Biotechnology.

CIMMYT maintains an extensive maize seedbank and supplies seeds on demand to research institutions and extension services around the developing world. "We needed to be able to reassure our users that transgenes were not running rampant through the seed bank and we have shown that," says David Hoisington, director of CIMMYT's Applied Biotechnology Center. Their initial results could not find the 35S promoter in any of the 28 maize populations in its seedbank. More importantly, they have started to examine materials that have been collected from farmers' fields in Oaxaca, the state where Chapela collected their materials.

One way to resolve the conflict would be for the various groups to share samples. It is important that several different and independent laboratories perform a parallel analysis of the same samples. "If they all see the same thing," says Hoisington, "then you can be more sure that there is really something there."

CIMMYT's results are in contrast to those earlier reported by Mexican government researchers and a study by Ignacio Chapela published in Nature Magazine in November 2001.

## ASIA INVESTS IN BIOTECHNOLOGY

Countries in Asia are giving high priority to biotechnology. On the lead is Singapore which is channeling billions of dollars in development fund to become the hub of biotechnology in the region.

China is not far behind. A recent study conducted by researchers in the US and China reveals that research and development on plant biotechnology is doing well in the country. Scott Rozelle, a professor in the Department of Agricultural and Resource Economics at the University of California (UC) Davis and colleagues surveyed 29 of China's plant biotechnology research institutes and interviewed research directors of the major plant biotechnology programs.

Rozelle notes that China has been accelerating its investments in agricultural biotechnology research and is making breakthroughs on commodities that have been mostly ignored in the laboratories of industrialized countries. "If China's success with GM cotton is any predictor of future achievements, we can expect that plant biotechnology in China will have a significant impact on world production, consumption, nutrition, and trade."

Joining Singapore and China are Malaysia, India and South Korea. The Malaysian Government strongly believes that biotechnology will propel the country into the new frontier of economic growth. It is set to invest US$3.7 billion to establish the Multi-Media Super Corridor (MSC) in which a Bio-valley will be located. Malaysian officials expect that the three biotechnology institutes will help to accelerate this new industry and attract foreign investment amounting to US$10 billion over the next 10 years.

India is also planning to increase investments in biotechnology over the next few years. The southern states of India have identified biotechnology as a thrust sector. By 2010, the Indian industry could grow to US$4.5 billion from the US$2.5 billion now.

Finally, South Korea expects to see a rise in investment in biotechnology over the next 5 years. By 2007, US$ 10 billion will be invested in biotechnology of which US$ 1.5 billion will be invested in the agriculture and food industries.

## REPORTS ON BT COTTON TRIALS FAVORABLE

Several agencies in India particularly the Indian Council of Agricultural Research (ICAR), Union Environment Ministry, and the Department of Biotechnology (DBT) generally aver that data on the Bt cotton trials in the country look favorable. The firm conducting the authorized trials is the Maharashtra Hybrid Seed Company (Mayco). Reports coming from ICAR and Mayco are up for evaluation by the Review Committee on Genetic Manipulation (RCGM), which will forward for further comments to the Ministry's Genetic Engineering Approval Committee (GEAC), the lone sanctioning authority for GM crops or food.

In case the commercialization of Bt cotton pushes through, this would be India's first commercialized transgenic crop.

In other developments, Pesticides Association of India Vice Chairman Pradip K. Mazumdar opined that his group is in favor of introducing genetically modified (GM) crops as long as it undergo the required tests.

Compared to countries like Japan and Taiwan, which uses an equivalent of US$633 and US$392 per hectare of pesticides respectively, India is one of the lowest pesticide users in the world at three dollars per hectare. There is opportunity to use pesticides in proper doses in regions plagued by pests even if GM seeds are given clearance for commercial release.

## KNOWLEDGE CENTER BICs TO MEET IN BANGKOK

Country representatives of Biotechnology Information Centers (BICs) in Southeast Asia and network links are congregating in Bangkok, Thailand on January 14 and 15 to review activities and plan projects for 2002. The BICs are the heart of the Global Knowledge Center on Crop Biotechnology network whose core operations are based in the SEAsiaCenter of the International Service for the Acquisition of Agri-biotech Applications. Expected to attend are participants from Indonesia, Malaysia, Philippines, Thailand and Vietnam.

The BICs are tasked with providing information on crop biotechnology and promoting public understanding of scientific advances in the field to specific stakeholders in their respective countries.

## ANNOUNCEMENTS

**Essential Biosafety CD** now available! If you still haven't ordered your copy of this excellent CD, then do so now by visiting http://www.essentialbiosafety.info and filling up the request form. This CD-ROM offers comprehensive information about the safety of genetically modified crops.

**Food Biotechnology: A Communication Guide to Improving Understanding CD** now available! This Guide aims to raise awareness of this communications issue, and provides lots of practical advice and resources to overcome this problem. For example, the Guide includes lists of "Words to use" and "Words to lose", and a slide presentation, which may be adapted according to audience needs and interests. Get your free copy now and e-mail us at knowledge.center@isaaa.org

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# CROP BIOTECH NET

## ISAAA PRESS RELEASE

January 10, 2002

**Global GM Crop Area Continues to Grow**

**and Exceeds 50 Million Hectares**

**for First Time in 2001**

The Annual Global Review of Commercialized Transgenic (GM) Crops, conducted by Dr Clive James, Chairman of the ISAAA Board of Directors, features comprehensive information on transgenic crops grown globally in 2001; the following are the highlights:

- The estimated global area of transgenic or GM crops for 2001, is 52.6 million hectares (has.) or 130.0 million acres, grown by 5.5 million farmers in thirteen countries. 2001 is the first year when the global area of GM crops has exceeded the historical milestone of 50 million has.
- The increase in area between 2000 and 2001 is 19%, equivalent to 8.4 million has. or 20.8 million acres. This increase is almost twice the corresponding increase of 4.3 million has. between 1999 and 2000, which was equivalent to an 11% growth.
- During the six-year period 1996 to 2001, global area of transgenic crops increased more than 30-fold, from 1.7 million has. in 1996 to 52.6 million has. in 2001.
- More than one quarter of the global transgenic crop area of 52.6 million has. in 2001, equivalent to 13.5 million has., was grown in six developing countries. Indonesia commercialized Bt cotton for the first time in 2001.
- In 2001, four principal countries grew 99% of the global transgenic crop area. The USA grew 35.7 million has. (68% of global total), followed by Argentina with 11.8 million has. (22%), Canada 3.2 million has. (6%) and China 1.5 million has. (3%); China had the highest year-on-year percentage growth with a tripling of its Bt cotton area from 0.5 million has. in 2000 to 1.5 million has. in 2001.
- Globally, the principal GM crops were GM soybean occupying 33.3 million has. in 2001 (63% of global area), followed by GM corn at 9.8 million has. (19%), transgenic cotton at 6.8 million has. (13%), and GM canola at 2.7 million has. (5%).
- During the six-year period 1996 to 2001, herbicide tolerance has consistently been the dominant trait with insect resistance second.
- In 2001, herbicide tolerance, deployed in soybean, corn and cotton, occupied 77% or 40.6 million hectares of the global GM 52.6 million has., with 7.8 million has. (15%) planted to Bt crops, and stacked genes for herbicide tolerance and insect resistance deployed in both cotton and corn occupying 8% or 4.2 million has. of the global transgenic area in 2001.
- The two dominant GM crop/trait combinations in 2001 were: herbicide tolerant soybean occupying 33.3 million has. or 63% of the global total and grown in seven countries; and Bt maize, occupying 5.9 million has., equivalent to 11% of global transgenic area and planted in six countries; the other six GM crops occupied 5% or less of global transgenic crop area.
- On a global basis, 46% of the 72 million has. of soybean grown worldwide were GM in 2001 - up from 36 % in 2000; 20% of the global 34 million has. of cotton were GM - up from 16 % in 2000; global areas planted to GM canola and maize, were unchanged from

2000 at 11% of the 25 million has. of canola, and 7% of the 140 million has. of maize. If the global areas (conventional and transgenic) of these four principal GM crops are aggregated, the total area is 271 million has., of which 19% is GM, up from 16% in 2000.

In the first six years, 1996 to 2001, a cumulative total of over 175 million has. (almost 440 million acres) of GM crops were planted globally and met the expectations of millions of large and small farmers.

The number of farmers that benefited from GM crops increased from 3.5 million farmers in 2000 to 5.5 million in 2001. More than three-quarters of the farmers that benefited from GM crops in 2001 were resource-poor farmers planting Bt cotton, mainly in China and also in South Africa.

There is cautious optimism that global area and the number of farmers planting GM crops will continue to increase in 2002

The above are excerpts from "Global Review of Commercialized Transgenic Crops: 2001", by Clive James, ISAAA Briefs No. 24: Preview. For media inquiries please contact Tel +1-345-947-1839 from 9.00 A.M. to 5.00 P.M. EST, New York, USA. The publication and further information can be obtained from ISAAA's SoutheastAsia Center: e-mail publications@isaaa.org. Cost of the publication, ISAAA Briefs No. 24, is $US 25.00 including postage. The publication is available free of charge to nationals of developing countries.

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CROP BIOTECH JANUARY 18, 2002

In This Issue:

South Africa Grows GM Corn and Soybean
* South Korea and China Issue Directives for GMO Products
* Reuters Survey Says US GM Corn Plantings To Increase
* UNEP Launches Project to Promote Biosafety
* African Scientists Issue Policy Statement on AgBiotech

## SOUTH AFRICA GROWS GM CORN AND SOYBEAN

South Africa is the world's first country that is into commercial planting of genetically modified (GMO) white corn. It is a staple food in many parts of the continent and is being exported by South Africa to southern African countries.

A report by the government's Crop Estimates Committee says that about 1,596,005 ha of white corn were planted in 2001/02 cropping season. Kit le Clus, head of research and development for Grain SA, said that less than 1 percent of white corn in South Africa is planted to the GM variety.

Jocelyn Webster, executive director of AfricaBio, a biotechnology association, stated that three companies namely Monsanto, Pioneer, and Pannar Seeds are involved in GM white corn. Monsanto's GM corn is planted on farms in KwaZulu-Natal, Free State, Eastern Cape and Mpumalanga. The first Pannar GM white corn hybrids will be commercially available in 2003/04 season once demonstration trials are completed.

The country also planted 7,000 ha of herbicide-tolerant soybeans. The South African government's Executive Council for Genetically Modified Organisms has approved the planting of GM soybean as well as herbicide-tolerant and insect-resistant cottons.

## SOUTH KOREA AND CHINA ISSUE DIRECTIVES FOR GMO PRODUCTS

South Korea's Ministry of Agriculture and Forestry recently issued guidelines for products derived from genetically modified organisms (GMOs) that are to be sold in the country. This step would help ensure consumers that the GMO products produced locally and abroad are of no potential danger to humans, animals and the environment.

The guideline stipulates that dealers of GMO products must submit an application to the Rural Development Administration (RDA) for product assessment. A 30-day period is given to consolidate public opinion and other pertinent information on the product. The authority will notify applicants about the results of their application within 270 days of its receipt.

Meanwhile, China's Ministry of Agriculture has issued details on the implementation of its guidelines on GMOs. One guideline is that overseas firms that export GMO products to China must obtain safety certificates from the Ministry prior to signing of a contract to sell. All imported GMO soybean, corn, rapeseed, cottonseed and tomatoes must be clearly labeled as GMO products. Beijing will put the policy into effect by March 20 of this year.

## REUTERS SURVEY SAYS US GM CORN PLANTINGS TO INCREASE

Growers surveyed by Reuters at the American Farm Bureau Federation's annual meeting in Las Vegas say that they will boost acreage of several genetically modified crops despite the anxiety

of its European and Asian neighbors. US corn plantings will escalate this year by as much as 13.8 to 19.3 percent depending on the variety. The increase appeared to be due mostly to the end of a year-long controversy over Starlink corn.

Another crop that was foreseen to grow is GM soybean at 8.3 percent. In contrast, GM cotton will shrink by as much as 8.4 percent for the Bt variety and 2.1 percent for the Roundup Ready variety due to global excess of the product.

## UNEP LAUNCHES PROJECT TO PROMOTE BIOSAFETY

The Global Environment Facility (GEF) will fund a project to help developing countries assess the potential risks and benefits from genetically engineered crops. Up to 100 countries will be assisted in building their capability to evaluate the health and environmental issues surrounding imports of Living Modified Organisms (LMOs).

This project will prepare developing countries as they prepare for the entry of the Cartegena Protocol on Biosafety which was adopted in January 2000. Nations exporting LMOs have to inform importing countries that they need appropriate scientific and legal skills to decide whether or not to accept LMOs into their countries. In addition, they need to know how to safely handle these organisms.

The United Nations Environment Programme (UNEP) will implement the three-year, multi-million dollar project. Klaus Toepler of UNEP says that "Industry is convinced that GM crops are the key to boosting yields in a more environmentally friendly way. But others are concerned that the new technology may actually pose environmental as well as health risks. The Cartegena Protocol is an attempt to reconcile these trade and environmental protection issues."

## AFRICAN SCIENTISTS ISSUE POLICY STATEMENT ON AGBIOTECH

The International Society of African Scientists (ISAS) issued a position statement stressing that agricultural biotechnology represents a major opportunity to enhance the production of food crops, cash crops, and other agricultural commodities in Africa, the Caribbean and other developing nations. The statement was based on the deliberations at a technical conference held in Wilmington, Germany.

Highlights of the policy statement include:

- Africa and the Caribbean cannot afford to be left further behind in acquiring the uses and benefits of this new agricultural revolution.
- Future research and applications of agricultural biotechnology should place particular emphasis on food production and agricultural needs of developing countries.
- Governments and civil society in African and the Caribbean nations must actively participate in the worldwide debate on the use of agbiotech. African scientists need to be at the forefront of this research and debate to help clarify the issues for their communities. African governments must develop policies and programs to foster rapid developments in agricultural biotechnology as an adjunct to other agricultural techniques.
- African and Caribbean governments must establish adequate regulatory oversight and appropriate scientific protocols for agricultural biotechnology.

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